Challenging topics

Collecting and interpreting data

Session 3: Choosing appropriate charts

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Introduction

Knowledge about the collection and interpretation of data is needed to support mathematical understanding in a range of vocational settings. Teachers* can modify the examples in these sessions to suit their particular vocational area by introducing relevant data sets or charts.

- * We use the word 'teacher' as a generic term to include teachers, tutors, trainers, lecturers and instructors in the further education (FE) system.

This is the third of a set of four sessions with a common theme. You can use each session individually or link them. Each session has a number of stages and activities, which can also be used separately or linked. Learners would benefit if these smaller units were delivered consecutively, with the teacher ensuring that the overall session coverage is achieved.

Learning objectives and outcomes

Taking part in this session will help learners to:

- choose appropriate charts to represent data
- be aware of the limitations of conclusions drawn from data analysis
- work co-operatively to build on prior knowledge and to explore and resolve misconceptions
- discuss mathematical problems, improving their ability to describe situations and concepts using appropriate mathematical language
- collaborate in solving problems, learn from each other and clarify their own understanding by engaging in activities that encourage discussion with their peers.

Resources required

For each small group of learners, you will need:

- **Sheet 1: Which is better?** (two pages)
- **Sheet 2: Discussion** (three pages)
- large sheets of paper (A2 would be ideal)
- felt tip pens.

Starting points

Learners will already have come across different types of charts but may not fully appreciate which type best illustrates particular data.

Planning learning in multiple environments

During discussion, draw on learners' own experience of charts. This may have been at school or college, in work experience, or in their current vocational course. Try, wherever possible, to relate the collection and interpretation of data to the wider vocational context by using vocationally relevant examples.

Time needed for this session: at least one hour

Suggested approach

Stage 1: Choosing and explaining the choice of a chart

Working in groups

Arrange learners in groups of two or three and prepare them to work co-operatively. If learners are unfamiliar with this way of working, the handout from **Session 1** (**Sheet 1: Discussing Mathematics**) may be helpful.

Explain the purpose of the activity and the learning objectives.

Give a copy of **Sheet 1: Which is better?** (two pages) to each small group of learners. They have to decide whether they think **Chart A** gives a better representation of the data than **Chart B**. They must also have a reason for their choice.

It is deliberate that these charts have no labels. The purpose is to focus learners' attention on the principles involved.

Comment

There are no absolute right or wrong answers in this task. All the charts show some aspects of the data well and others not so well, so it is important that any observation is justified by the learners. Learners may come up with some really interesting ideas.

Possible comments might include:

- In Set 1, one group is so much bigger than the rest that it makes the small bars in the bar chart difficult to see. It is impossible to read their values accurately as the scale is chosen to accommodate the larger bar. The pie chart is better at showing proportions (for example, you can see that the smaller groups together make up about a tenth of the total). However, the number in each group cannot be seen and it is still hard to see differences between the small sectors.

- In Set 2, it is difficult to see on the pie chart whether some groups are bigger than others. This is easier to see in the bar chart although the relative proportion for each group is much more difficult to interpret.

- In Set 3, it is much easier to compare two similar data sets in a side-by-side bar chart than in two separate charts.

Stage 2: Using charts for comparison

Working in groups

Give a copy of **Sheet 2: Discussion** (three pages) to each small group of learners. Describe the scenario that a group of learners have been given some data and they have to analyse it in order to decide whether it shows that males smoke more than females or vice versa. This is a discussion between the learners trying to do the analysis. Ask them to read it through and come up with an explanation of what was wrong with the first bar chart and how it was resolved.

Comment

Hopefully learners will realise from the first bar chart that there were more males in the sample than females and do the bar for males exceeds the corresponding bar for females. The heights of the bars are therefore misleading.

When a pie chart is used, both sets of data are plotted as proportions (or fractions) and not as frequencies, for example, 30 out of 60 will be 180 degrees but so will 45 out of 90 and 57 out of 114 and so on. This makes it easier to make comparisons between the data for males and females.

The final bar chart is similar to the pie charts in the sense that the frequencies have been reduced to percentages, so both are out of 100. For example, 20 out of 80 is 25% but so is 14 out of 56 and 70 out of 280.

Using percentages, proportions or fractions makes comparison fair when the original totals are different.

When they have finished, each group should write down at least one advantage and one disadvantage of using each type of chart when comparing data.

Comment

Bar charts allow you to read the frequency accurately but they are not so good if you want to show proportions of the whole. Also, if comparisons between two sets of data are required, either the totals for each set must be the same, or percentages must be used. Pie charts show proportions much better and can be used to compare two data sets even if there are different totals. However, they do not show small differences very well and you cannot read the original frequencies easily.

You may need to do some work on percentages at this point. If learners are going to draw charts using percentages they need to know that, for example, 54 out of 80 is the same as $54 \div 80 \times 100\%$.


**Sheet 1: Which is better?** (**page 1 of 2**)

Set 1

Chart A
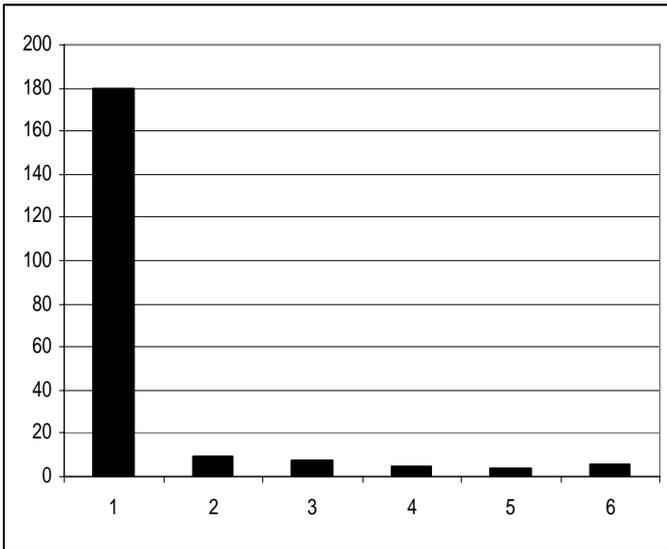
Chart B
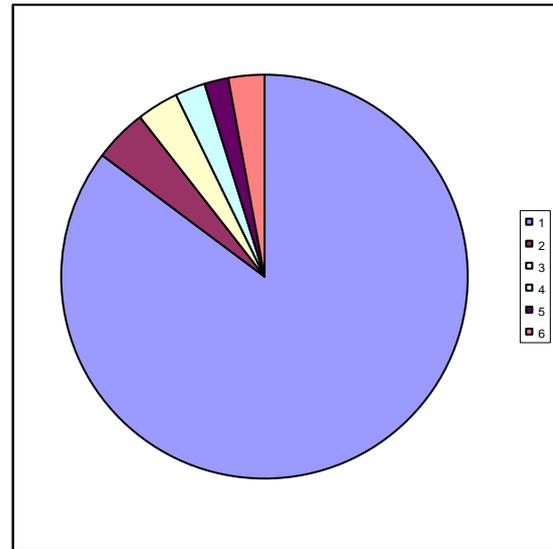
Set 2

Chart A
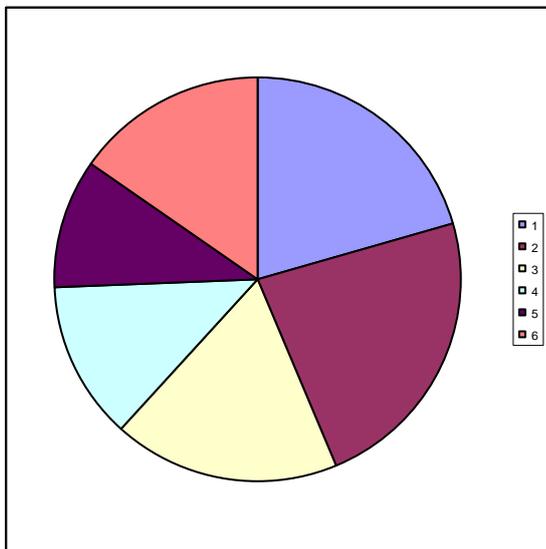
Chart B
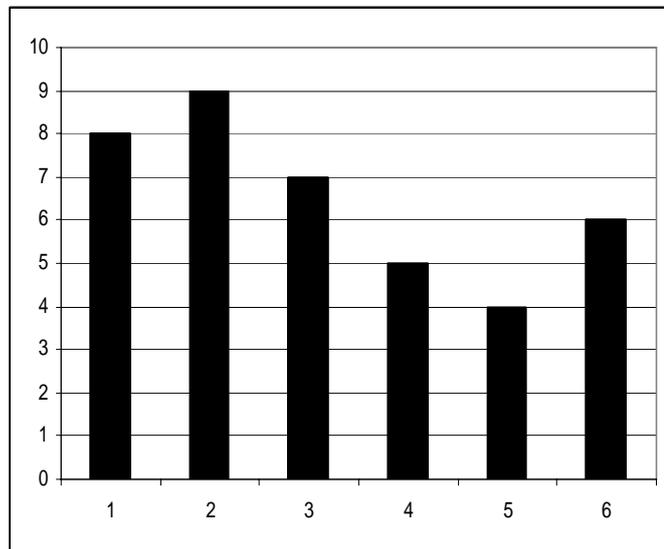
Sheet 1: Which is better? (page 2 of 2)

Set 3

Chart A
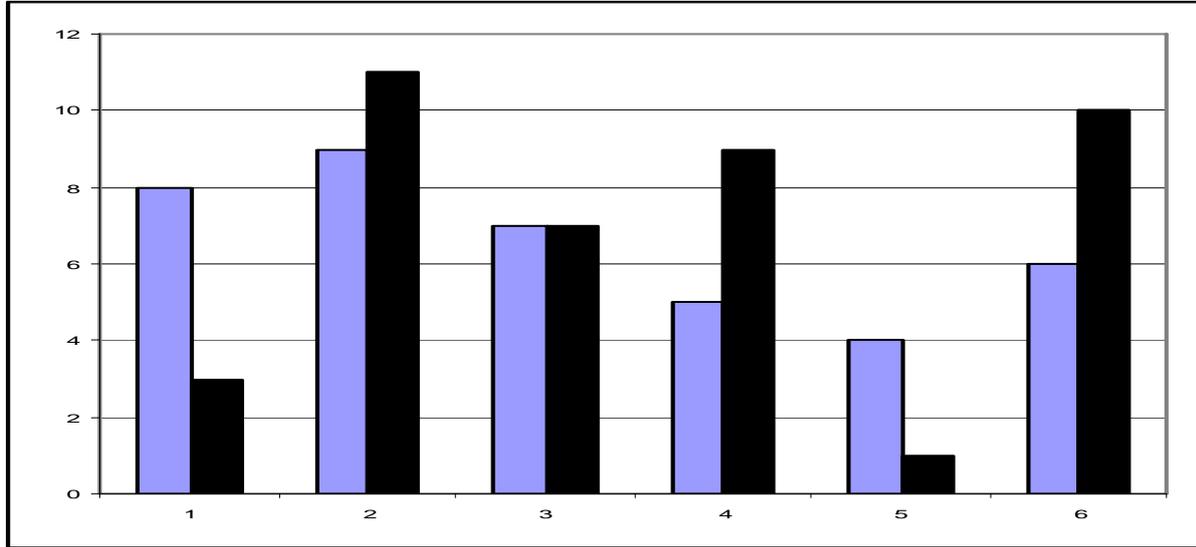
Charts B

Sheet 2: Discussion (page 1 of 3)

Smoking in 16 to 18 year olds

Number of 16 to 18 yr olds per day

Number of cigarettes per day

Legend: Male, Female
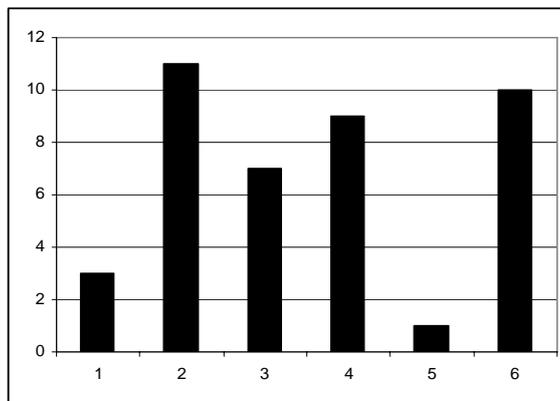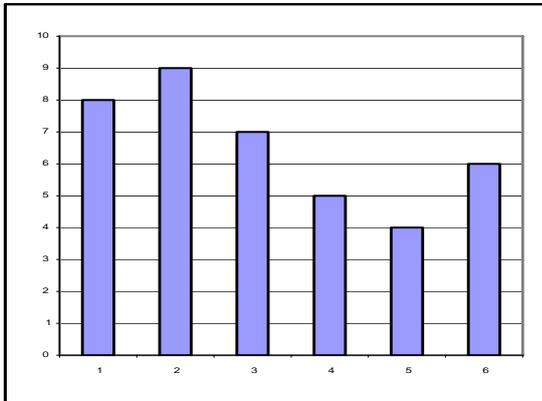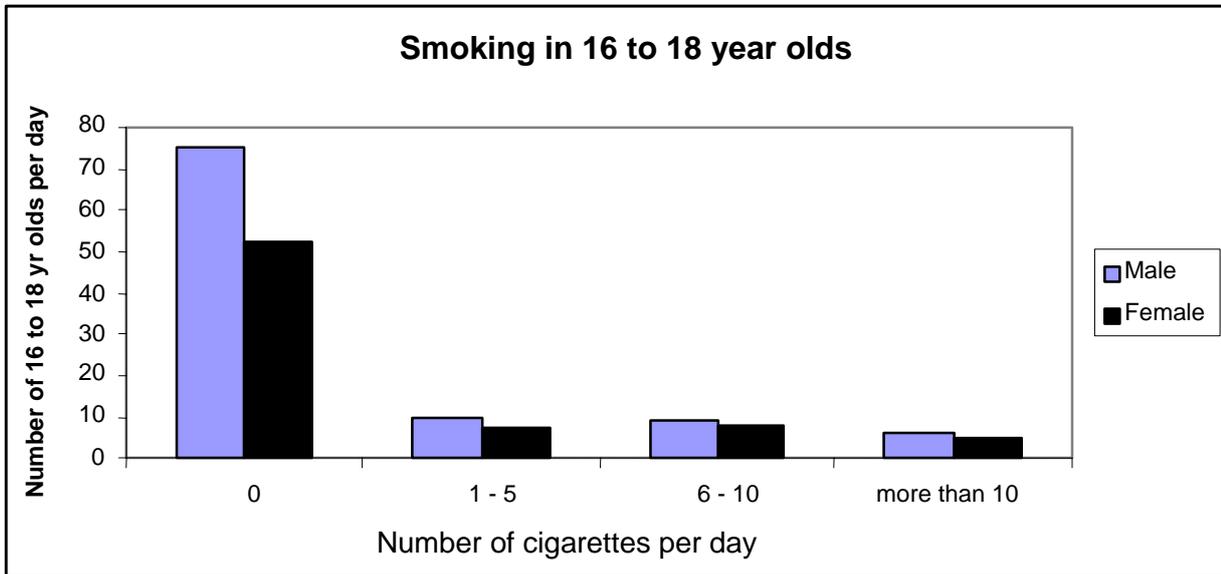
This bar chart shows clearly that males smoke less than females. There are clearly more males that do not smoke than females.

But there are more males who smoke more than 10 a day so that means males smoke more than females.

Well it's got to be one or the other. It can't be both. Which is it?

Could it be both – some males smoke lots and some don't smoke at all, but females smoke a kind of average amount so it all balances out?

I'm not sure about that – sounds a bit vague to me.

I'm confused. Is there any other way of looking at it?

Sheet 2: Discussion (page 2 of 3)

Male

- 0 cigarettes
- 1 - 5 cigarettes
- 6 - 10 cigarettes
- more than 10 cigarettes

Female

- 0 cigarettes
- 1 - 5 cigarettes
- 6 - 10 cigarettes
- more than 10 cigarettes
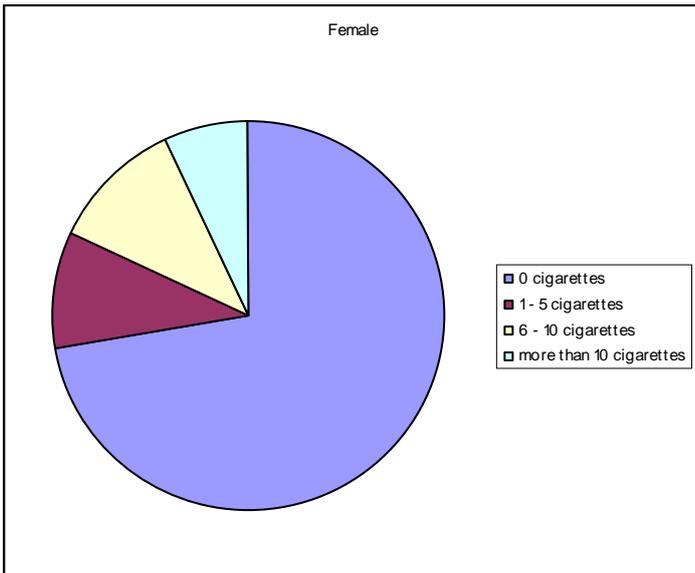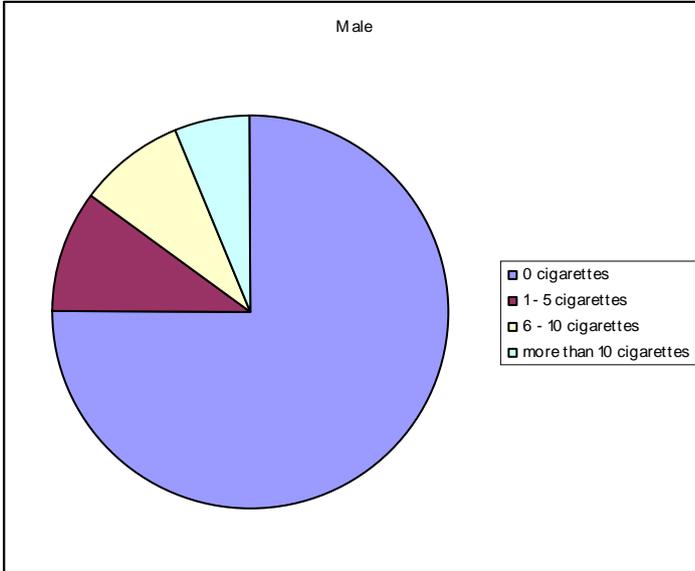
I've drawn two pie charts instead and look what they show.

They seem to show that females definitely smoke more than males. There are fewer who smoke none and more who smoke more than 10 a day.

That's much clearer – I think I will always use pie charts from now on.

Are you sure? What happens if you want to compare the number of females and males who smoke one to five a day. Which is bigger?

Sheet 2: Discussion (page 3 of 3)

I can't tell. It's easy to compare the group for 10 or more cigarettes and the group for no cigarettes. I think I would have to put one on top of the other to be sure which was bigger. I give up!

Well what about these charts?

Smoking in 16 to 18 year olds

% of 16 to 18 year olds

80
70
60
50
40
30
20
10
0

0   15   6-10   more than 10

Number of cigarettes per day

■ Male
■ Female
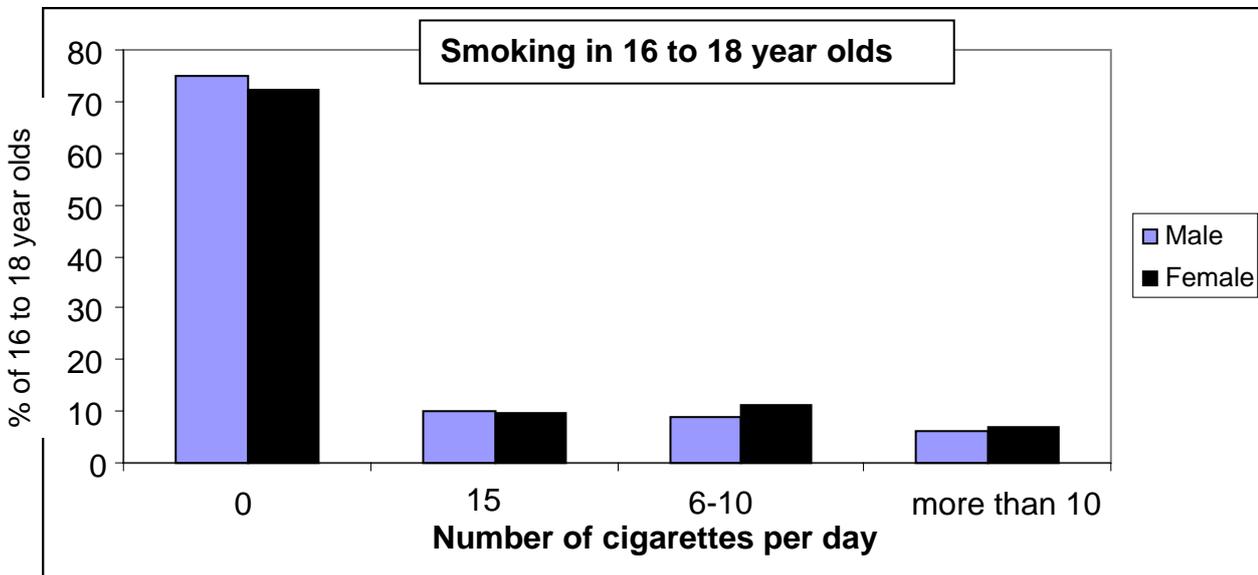
What exactly was the problem with the bar chart before? I don't understand. Please explain.

Well…