

Challenging topics

Collecting and interpreting data

Session 2: Calculating averages

Tackling challenging topics

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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.

This is the second 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.

We use 'teaching and learning' and 'teacher' as generic terms to include:

- teaching, training and learning
- teachers, tutors, trainers, lecturers and instructors in the further education (FE) system.

Learning objectives and outcomes

Taking part in this session will help learners to:

- calculate averages
- choose an appropriate average to use
- 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, learning from each other and clarifying 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: An average exercise**
- **Sheet 2: Using averages**
- large sheets of paper (A2 would be ideal)
- felt tip pens.

For each learner you will need:

- mini whiteboard.

Starting points

Most learners will have some prior knowledge of averages but this can be assessed during the first activity.

Planning learning in multiple environments

During discussion, draw on learners' own experience of using averages. This may have been in everyday life, on previous courses at school or college, in work experience or in their current vocational course. Try, wherever possible, to relate this work on averages to the wider vocational context by using vocationally relevant examples.

Time needed for this session

Between 1 hour and 1.5 hours, depending on how much detail is provided with the poster and how many open questions are used in Stage 2.

Suggested approach

Stage 1: Assessing prior learning

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 large sheet of paper and coloured felt tip pens to each pair of learners. Ask them to write the word 'Average' in the middle. Ask them to surround this with as much as they know about averages and examples of where they are used. This can include mathematical averages and how to work them out (if they can remember) but also where the word 'average' is used in everyday conversation, for instance, in conversation, 'How was your day?' 'Just average.'

Stick all the posters up at the front of the classroom and ask each pair of learners to talk about one aspect of their poster. Ensure that mean, median and mode are mentioned. Part of the discussion could revolve around which average was used in a particular example and why the other ones were not. Look at all the uses of 'average' and come up with an idea of what 'average' means in the full range of contexts in which it is used, for example, mathematically it means a representative value, but in conversation it is used more to mean 'typical' or 'normal'.

Stage 2: Calculating averages

Working in groups

Give each group a copy of **Sheet 1: An average exercise** and ask them to go through it correcting all the errors and writing comments that would help the learner who completed it to understand the mistakes they have made.

Comment

- Question 1: The median is halfway between the third and fourth numbers, that is, it is 7.5.
- Question 2: The median is halfway between 8 and 8, that is, it is 8.
- Question 3: The numbers need to be put in order before finding the median.
- Question 4: The median has been given instead of the mean.
- Question 5: The zeros should be included, so there are ten numbers not seven.
- Question 6: There are more 1s than 4s.

Class discussion

Use class discussion to ensure that everyone has spotted and understands all the errors.

Give each learner a mini whiteboard and ask some open questions to check that they can calculate each average. For example:

- Give me an example of a data set that has a median of 4.
- Give me an example of a data set that has a mean of 5.
- Give me an example of a data set that has a mode of 3 and a median of 6.

For each question, ask the learners to hold up their boards. Select a few sets to put on the board. Ask learners to decide whether they think these are correct and to suggest changes to correct any that are wrong.

Stage 3: Reviewing the learning – misleading headlines

Working in groups

Give out **Sheet 2: Using averages** and ask learners to look at each newspaper headline and report. Ask them to comment on why the use of the word 'average' in these situations is misleading.

Class discussion

Take each newspaper headline in turn and ask each small group to offer one comment about why it is misleading. Record their reasons on the board. Discuss how the misleading interpretation could be corrected.

Comment

Hedon United

Although Hedon United have bought players at a higher mean price than Paull Town, the price of the expensive player has caused this high mean and given a false impression. In fact the other three signings each cost less than the players bought by Paull Town. The median would probably be a better average to use in this situation.

Teenagers

Only one out of ten dads had used a mobile phone but the one who had used it so much that the mean was relatively high. In this situation it is probably not appropriate to use an average at all as both the mode and the median would give zero, which also gives a distorted representation.

Children

The article has taken the average as a value that represents every child, that is, the writer has assumed that all children are average. Some children never play computer games; in fact there may not be a single child in the country whose computer game time was 0.9 hours and is now 1.7 hours. The mean may be the best representation but it should be used properly.

Above average

It is impossible for every child to be above average; for some to be above average, others must be below. Technically it is possible for no child to be below average but only if every child is identical. As standards improve over time, it is possible that every child in the future will score above today's average score.

Sheet 1: An average exercise

1. Find the median of the set of numbers: 2, 5, 7, 8, 9, 12

Answer: There are 6 numbers so the median is the third which is 7

2. Find the median of the set of numbers: 4, 7, 8, 8, 9, 12

Answer: Median is 8.5

3. Find the median of the set of numbers: 3, 6, 12, 15, 11, 21, 15, 16, 22

Answer: Median is 11

4. Find the mean of the set of numbers: 3, 11, 12

Answer: Mean is 11

5. Find the mean of the set of numbers: 0, 0, 0, 1, 2, 2, 3, 3, 5, 5

Answer: Mean is $21 \div 7 = 3$

6. Find the mode of the set of numbers: 1, 3, 1, 3, 1, 2, 3, 4, 4, 4, 1, 2

Answer: Mode is 4

Sheet 2: Using averages

Hedon United spend an average of twice as much on each new player!

Over the last few weeks both Hedon United and Paull Town have bought new players but Hedon United have spent an average of £4 million whereas Paull Town have spent a mere £2 million on average.

The most expensive player was Tim Wall who cost Hedon United £13 million – their other three new signings cost £1 million each. Paull Town, on the other hand, paid between £1.5 million and £3 million for each of their new players.

Teenagers lose out to parents!

Sixteen-year-olds make fewer calls on their mobile phones than their parents.

In a survey of a group of 10 teenagers and their parents, it turned out that the average number of calls made by the teenagers the previous day was 5.3. The number of calls they made ranged from three to seven.

However the dads who were asked made an average of 6.5 calls, even though nine of the ten dads questioned admitted they had not used their phone the previous day. Mr Ingram, one of the dads, revealed that he made a massive 65 calls. He explained that he used his phone as part of his job.

Children of today spend twice as long on computer games as they did two years ago

A survey has found that 10-year-olds spend an average of 1.7 hours per day on computer games. A similar survey two years ago found that the average time was only 0.9 hours. Concern has been expressed at these findings. 'It is very worrying that our children are spending so much time playing computer games' said a leading child psychologist, 'We will have a generation who do not read books or take part in discussions.'

All children have a right to be above average

Schools should ensure that no child is below average in maths and English, said the shadow spokesperson on Education at a meeting of head teachers today.