PD4 • Managing discussion

Purpose

To encourage participants to:

- experience discussion of mathematics;
- reflect on how discussion can be used to promote learning;
- explore the characteristics of purposeful discussion;
- explore the management skills that are needed to implement purposeful discussion.

Materials required

For each participant you will need:

- Sheet PD4.2 – *Why is discussion rare in mathematics?*;
- Sheet PD4.3 – *What kind of talk is most helpful?*;
- Sheet PD4.4 – *Two examples of learner–learner talk*;
- Sheet PD4.5 – *Ground rules for learners*;
- Sheet PD4.6 – *Small group discussion: the teacher's role*;
- Sheet PD4.7 – *The purposes of whole group discussion*;
- Sheet PD4.8 – *Whole group discussion: the teacher's role*;
- Sheet PD4.9 – *Putting a session into action and reporting back*.

For each pair of participants you will need:

- Card set PD4.1 – *Always, sometimes or never true*;
- large sheet of paper for making a poster;
- glue stick;
- felt-tip pen;
- scissors.

For the final activity, participants will need to choose from the resource a session that will be most appropriate for their learners.

Supporting materials

To support this session, you may wish to use:

- extracts from the DVD-ROM *Thinking about learning/Thinking about discussion*
- PowerPoint presentation in *Materials/Professional development* on the DVD-ROM. This will be useful when running the session and includes slides of the aims, and of appropriate handouts and tasks.

Time needed

From 1 to 2 hours.

Suggested activities

1. Discussing mathematics: always, sometimes or never true?

One type of activity in the resource involves evaluating mathematical statements. Sheet PD4.1 – *Always, sometimes or never true?* contains a similar activity written at a level appropriate for a group of participants to work on together.

Ask participants to work in pairs. Introduce the activity as follows.

> You have been given a number of mathematical statements.
>
> Your task is to work collaboratively to produce a poster showing your thinking.
>
> In your pair:
>
> - choose a statement;
> - work together to decide whether the statement is always, sometimes or never true and justify your reasoning.
>
> Stick your statement on the poster and write your explanation next to it.
>
> - If you consider a statement to be always true, explain how you know this.
> - If you think a statement is sometimes true, describe all the cases when it is true and all the cases when it is false.
> - If you think a statement is never true, explain how you can be sure.
>
> Finally, make up a statement that your learners could discuss in a similar way.

Ask participants to work on the statements together and then share their responses with the whole group.

Discuss the dynamics of the discussion you have just had.

- Who talked the most? Who spoke the least? What was their role in the group?
- Did everyone feel that all views were taken into account?
- Did anyone feel threatened? If so, why? How could this have been avoided?
- Did people tend to support their own views, or did anyone take up and improve someone else's suggestion?
- Has anyone learnt anything? If so, how did this happen?

2. Why is discussion rare in mathematics?

Introduce this question and generate a list of suggestions from the group.

Give each participant a copy of Sheet PD4.2 – *Why is discussion rare in mathematics?* This contains real concerns and opinions expressed by teachers. Which of these do participants agree with? Ask participants to work in pairs to choose one of the comments and to take a few minutes to prepare a response. In the whole group, discuss these choices and the responses.

If there is time you might want to set the scene for the following activities by showing *Thinking about learning/Thinking about discussion/Overview* from the DVD-ROM.

3. What kind of talk is most helpful?

Give out copies of Sheets PD4.3 – *What kind of talk is most helpful?* and PD4.4 – *Two examples of learner–learner talk*. PD4.3 describes three types of talk: cumulative, disputational, and exploratory. Discuss the differences, referring to the characteristics of the discussions in PD4.4. How would participants classify these types of talk? Which type is most helpful and why?

Show the extract *Thinking about learning/Thinking about discussion/Example 2* from the DVD-ROM. Encourage participants to identify examples of exploratory talk. This is the most helpful kind, where learners listen and help each other to reason.

4. Setting ground rules for learners

Learners are often unused to discussions in mathematics, although they are used quite frequently in their other subjects. Ask participants to describe how they might prepare learners for a discussion. What difficulties would participants anticipate? What 'ground rules' would they set?

Give each participants a copy of Sheet PD4.5 – *Ground rules for learners* and discuss how these should be introduced to and reinforced with a group of learners.

5. Managing a discussion

Discuss the following questions in the whole group.

- How might we help learners to discuss constructively?
- What is the teacher's role during small group discussion?
- What is the purpose of a whole group discussion?
- What is the teacher's role during a whole group discussion?

When participants have had a chance to discuss these issues, give out Sheets PD 4.6 – *Small group discussion: the teacher's role*, PD4.7 – *The purposes of whole group discussion* and PD4.8 – *Whole*

group discussion: the teacher's role. Discuss the suggestions they contain.

If you have time, you could show the video sequence *Thinking about learning/Thinking about discussion/Example 3* on the DVD-ROM. You will see a number of teachers managing small group discussions. This can be used as a stimulus to the group and you can focus on particular techniques and strategies. There is also a short sequence of these teachers and their learners reflecting on these strategies.

6. Putting a session into action and reporting back

Give out Sheet 4.9 and ask participants each to plan a discussion session for their own learners, based round one of the sessions in the resource.

They should consider the following questions with specific reference to that session.

- How should I organise the furniture?
- Will learners need to move about during the session?
- How should I introduce the main task and the ways of working on it?
- Is it better to give the learners a chance to work on the task individually, before moving them into pairs or groups?
- How will learners be allocated to groups? What criteria will I use?
- How will I organise the rhythm of the session? (For example, individuals could work on their own, then move into pairs, then into fours, then report back to the whole group, followed by a grand summing up.) How much time will I allocate to each phase?
- How will I conclude the session?

Arrange follow-up meetings where participants can share with their colleagues what happened. Encourage them to talk about failures as well as successes.

If there is time you might like to show the sequence *Thinking about learning/Thinking about discussion/Example 1* from the DVD-ROM. In this sequence, you can hear teachers talking about issues that affect their own planning for activities that involve discussion.

Card set PD4.1 – *Always, sometimes or never true?*

Numbers with more digits are greater in value.	The square of a number is greater than the number.
When you cut a piece off a shape, you reduce its area and perimeter.	A pentagon has fewer right angles than a rectangle.
$\sqrt{ab} > \frac{a + b}{2}$	Quadrilaterals tessellate.
If a right-angled triangle has integer sides, the incircle has integer radius.	If you square a prime number, the answer is one more than a multiple of 24.
If you add n consecutive numbers together the result is divisible by n.	If you double the lengths of the sides, you double the area.
Continuous graphs are differentiable.	If the sequence of terms tends to zero, the series converges.

Sheet PD4.2 – *Why is discussion rare in mathematics?*

Time pressures	**'It's a gallop to the main exam.'** **'Learners will waste time in social chat.'**
Control	**'What will other teachers think of the noise?'** **'How can I possibly monitor what is going on?'**
Views of learners	**'My learners cannot discuss.'** **'My learners are too afraid of being seen to be wrong.'**
Views of mathematics	**'In mathematics, answers are either right or wrong – there is nothing to discuss.'** **'If they understand it there is nothing to discuss. If they don't, they are in no position to discuss anything.'**
Views of learning	**'Mathematics is a subject where you listen and practise.' 'Mathematics is a private activity.'**

Sheet PD4.3 – *What kind of talk is most helpful?*

Cumulative talk	**Speakers build positively but uncritically on what each other has said. This is typically characterised by repetitions, confirmations and elaborations.**
Disputational talk	**This consists of disagreement and individual decision-making. It is characterised by short exchanges consisting of assertions and counter-assertions.**
Exploratory talk	**Speakers work on and elaborate each other's reasoning in a collaborative rather than competitive atmosphere. Exploratory talk enables reasoning to become audible and knowledge becomes publicly accountable. It is characterised by critical and constructive exchanges. Challenges are justified and alternative ideas are offered.**

Source: Mercer N. *Words and minds*, London, 2000, Routledge.

Sheet PD4.4 Two examples of learner–learner talk

Evaluating algebraic expressions

Are the following algebraic statements, always, sometimes or never true?

$$2n + 3 = 3 + 2n$$
$$2t - 3 = 3 - 2t$$
$$3 + 2y = 5y$$
$$p + 12 = s + 12$$
$$4p > 9 + p$$

Sam: $2n + 3 = 3 + 2n$. Sometimes true.

Jane: That's what I put down.

Sam: $2t - 3 = 3 - 2t$. That's more like that. I've never seen anything like this before.

Jane: Sometimes true.

Sam: It might be…That one is an add.

Jane: Take away, take away. Let's leave that one and go onto the next one.

Sam: $3 + 2y = 5y$

Jane: That's true.

Sam: That's true. Because if you add 2 you get $5y$. It's true.

Sam: $p + 12 = s + 12$. That's not true.

Jane: Never true.

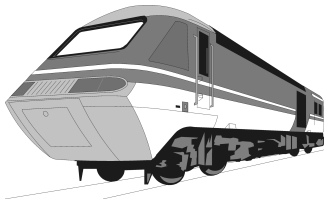
Sam: Never heard of that before.

Sam: $4p$ is greater than $9 + p$. Eh? We don't know what p is though. 9 is greater than 4 though isn't it.

Jane: I've got no clue for that one.

(They leave it out.)

Rail prices



In January, fares rose by 20%.

In August, they fell by 20%.

Sue claims that:

"The fares are now back to what they were before the January increase."

Do you agree?

If not, what has she done wrong?

Harriet: That's wrong, because . . . they went up by 20%, say you had £100 that's 5, no 10.

Andy: Yes, £10 so its 90 quid, no 20% so that's £80. 20% of 100 is 80, . . . no 20.

Harriet: Five twenties are in a hundred.

Dan: Say the fare was £100 and it went up by 20%, that's £120.

Sara: Then it went back down, so that's the same.

Harriet: No, because 20% of 120 is more than 20% of 100. It will go down by more so it will be less. Are you with me?

Andy: Would it go down by more?

Harriet: Yes because 20% of 120 is more than 20% of 100.

Andy: What is 20% of 120?

Dan: 96 . . .

Harriet: It will go down more so it will be less than 100.

Dan: It will go to 96.

Sheet PD4.5 – *Ground rules for learners*

Discussing maths

Why discuss maths?

Many people think that there isn't much to discuss in maths. After all, answers are just right or wrong aren't they?

There is more to learning maths than getting answers. You need discussion in order to learn:

- what words and symbols mean;
- how ideas link across topics;
- why particular methods work;
- why something is wrong;
- how you can solve problems more effectively.

Teachers and trainers often say that they understand maths better when they start teaching it. In the same way, you will find that, as you begin to explain your ideas, you will understand them better.

As you begin to understand maths, you will remember it more easily and, when you do forget something, you will be able to work it out for yourself.

Some don'ts

- **Don't rush**
  It is more important to get a better understanding than to finish the activity.
- **Don't be a passenger**
  Don't let someone in your group 'take over'.

Stick to these basic rules and you will find that:

- you begin to enjoy maths more;
- you learn more from others;
- you find that your difficulties are the same as those experienced by others;
- you can help others too.

Some dos

- **Talk one at a time**
  Give everyone a chance to speak. Take it in turns to put forward ideas, explanations and comments. Let people finish.
- **Share ideas and listen to each other**
  If you don't understand what someone has said, keep asking 'why?' until you do understand. Ask them to give an example, draw a diagram or write down their explanation.
- **Make sure people listen to you**
  If you have just said something and are not sure if people understood you, ask them to repeat what you have just said in their own words.
- **Follow on**
  Try to say something that follows on from what the last person said.
- **Challenge**
  If you disagree with what people say, then challenge them to explain. Then put your point of view.
- **Respect each other's opinions**
  Don't laugh at other people's contributions (unless they're meant to be funny).
- **Enjoy mistakes**
  Don't worry about making mistakes. If you don't make mistakes, you cannot learn anything. It is sometimes interesting to make deliberate mistakes to see if your partner is listening.
- **Share responsibility**
  If the teacher asks your group to report back, make sure anyone in your group can do so.
- **Try to agree in the end**

Sheet PD4.6 – *Small group discussion: the teacher's role*

Make the purpose of the task clear

Explain what the task is and how they should work on it. Also, explain why they should work in this way. 'Don't rush, take your time. The answers are not the focus here. It's the **reasons** for those answers that are important. You don't have to finish, but you do have to be able to explain something to the rest of the group.'

Keep reinforcing the 'ground rules'

Try to ensure that learners remember the ground rules that were discussed at the beginning. Encourage learners to develop a responsibility for each other's understanding. 'I will pick one of you to explain this to the whole group later – so make sure all of you understand it'.

Listen before intervening

When approaching a group, stand back and listen to the discussion before intervening. It is all too easy to interrupt a group with your own predetermined agenda, diverting their attention from the ideas they are discussing. This is not only annoying and disruptive (for the group), it also stops learners concentrating.

Join in, don't judge

Try to join in as an equal member of the group rather than as an authority figure. When teachers adopt judgmental roles, learners tend to try to 'guess what's in the teacher's head' rather than try to think for themselves: 'Do you want us to say what we think, or what we think you want us to say?'

Ask learners to describe, explain and interpret

The purpose of an intervention is to increase the depth of reflective thought. Challenge learners to describe what they are doing (quite easy), to interpret something ('can you say what that means?') or to explain something ('can you show us why you say that?).

Do not do the thinking for learners

Many learners are experts at making their teachers do the work. They know that if they 'play dumb' long enough, the teacher will eventually take over. Try not to fall for this. If a learner says that they cannot explain something, ask another learner in the group to explain, or ask the learner to choose some part of the problem that they can explain. Don't let them off the hook. When a learner asks you a question, don't answer it (at least not straight away). Ask someone else in the group to answer.

Don't be afraid of leaving discussions unresolved

Some teachers like to resolve discussions before they leave the group. When the teacher leads the group to the answer, then leaves, the discussion has ended. Learners are left with nothing to think about, or they go on to a different problem. It is often better to reawaken interest with a further interesting question that builds on the discussion and then leave the group to discuss it alone. Return some minutes later to find out what they have decided.

Sheet PD4.7 – *The purposes of whole group discussion*

Presenting and reporting	**Learners may be asked to describe something they have done, an answer they have obtained and their method for obtaining it, or to explain something they have learned. Their ideas may be compared and evaluated by the whole group.**
Recognising and valuing	**Some of the ideas generated in the discussion will be more important and significant than others. It is the teacher's role to recognise these 'big ideas', make them the focus of attention and give them status and value.**
Generalising and linking	**This involves showing how the ideas generated in the session may be developed and used in other situations. Learning is thus put into a wider context.**

Sheet PD4.8 – *Whole group discussion: the teacher's role*

The suggestions below have been found useful in promoting discussions in which learners feel able to exchange ideas. Learners are usually only able to participate if they have first done some preliminary talking about the issues in pairs or small groups. Remember to allow time for this.

Mainly be a 'chairperson' or 'facilitator' who:

- directs the flow of the discussion and gives everyone a chance to participate;
- does not interrupt or allow others to interrupt the speaker;
- values everyone's opinion and does not push his or her point of view;
- helps learners to clarify their own ideas in their own words.

> Listen to what Jane is saying.
> Thanks, Harpreet, now what do you think Hannah?
> How do you react to that, Tom?
> Are there any other ideas? Could you repeat that please, Ali?

Occasionally be a 'questioner' or 'challenger' who:

- introduces a new idea when the discussion is flagging;
- follows up a point of view;
- plays devil's advocate;
- focuses on an important concept;
- asks provocative questions, but not 'leading', or 'closed' questions.

> What would happen if…?
> What can we say about the point where the graph crosses the x axis?

Don't be a 'judge' or 'evaluator' who:

- assesses every response with a 'yes', 'good' or 'interesting'. This tends to stop others contributing alternative ideas and encourages externally acceptable performances rather than exploratory dialogue.
- sums up prematurely.

> That's not quite what I had in mind.
> You're nearly there.
> Yes, that's right.
> No, you should have said…
> Can anyone see what's wrong with Kwanele's answer?

Adapted from Swan M. *The Language of Functions and Graphs*, Shell Centre for Mathematical Education, University of Nottingham, 1985.

Sheet PD4.9 – *Putting a session into action and reporting back*

Plan a discussion session for your own learners, based round one of the sessions in the resource. You should consider the following questions.

- How should I organise the furniture?

- Will learners need to move about during the session?

- How should I introduce the main task and the ways of working on it?

- Is it better to give the learners a chance to work on the task individually, before moving them into pairs or groups?

- How will learners be allocated to groups? What criteria will I use?

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- How will I conclude the session?

Arrange a follow-up meeting where you can share what happened with your colleagues. Try to talk about failures as well as successes.