Questions and prompts for primary trainees: Mentoring conversations for the teaching and learning of mathematics

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This document comprises a series of questions and prompts designed to support in-school mentors and link tutors in developing sharply focused mentoring conversations with trainee teachers about their planning, teaching, and assessment of mathematics.

The questions and prompts are structured around the NCETM's 5 Big Ideas in Teaching for Mastery: https://www.ncetm.org.uk/teaching-for-mastery/mastery-explained/five-big-ideas-in-teaching-for-mastery/

They are intended to be used flexibly and contingently to provide well-matched and progressive challenge through the early, middle and later stages of initial training.

These materials were created by a group of ITT providers in the East Midlands as part of an NCETM-funded project on behalf of the three East Midlands maths hubs.

May 2021

MathsHUBS East Midlands South

MathsHUBS East Midlands East

MathsHUBS East Midlands West

The following description of the **Five Big Ideas in Teaching for Mastery** is taken from the NCETM website: https://www.ncetm.org.uk/teaching-for-mastery/mastery-explained/five-big-ideas-in-teaching-for-mastery/

A central component in the NCETM/Maths Hubs programmes to develop Mastery Specialists has been discussion of Five Big Ideas, drawn from research evidence, underpinning teaching for mastery. A true understanding of these ideas will probably come about only after discussion with other teachers and by exploring how the ideas are reflected in day-to-day maths teaching, but here's a flavour of what lies behind them:

Coherence

Lessons are broken down into small, connected steps that gradually unfold the concept, providing access for all children and leading to a generalisation of the concept and the ability to apply the concept to a range of contexts.

Representation and Structure

Representations used in lessons expose the mathematical structure being taught, the aim being that students can do the maths without recourse to the representation.

Mathematical Thinking

If taught ideas are to be understood deeply, they must not merely be passively received but must be worked on by the student, thought about, reasoned with, and discussed with others.

Fluency

Quick and efficient recall of facts and procedures and the flexibility to move between different contexts and representations of mathematics.

Variation

Variation is twofold. It is firstly about how the teacher represents the concept being taught, often in more than one way, to draw attention to critical aspects, and to develop deep and holistic understanding. It is also about the sequencing of the episodes, activities and exercises used within a lesson and follow up practice, paying attention to what is kept the same and what changes, to connect the mathematics and draw attention to mathematical relationships and structure.x

Some ways we are starting to use this document

I have used the document with a small group of PGCE 'primary with maths' trainees at the start of the school year. Before a twilight session on NCETM's 5 big ideas of mastery, the trainees completed some self-directed learning from the NCETM website.

I then shared this *Questions and Prompts* document at the start of the twilight. The trainees reported that they found it really useful to see the elements broken down and to see what progression in these elements might look like. This felt particularly valuable as the trainees were just at the start of their development as teachers of maths, and seeing the big ideas presented this way made them more accessible.

To help the trainees to engage with one of these, we watched a 'lesson walk-through' (recorded by a local Primary Mastery Specialist who is a member of this group) and I paused the video regularly to ask the trainees to refer to the *Questions and Prompts* document and reflect on how that big idea had been present in the lesson.

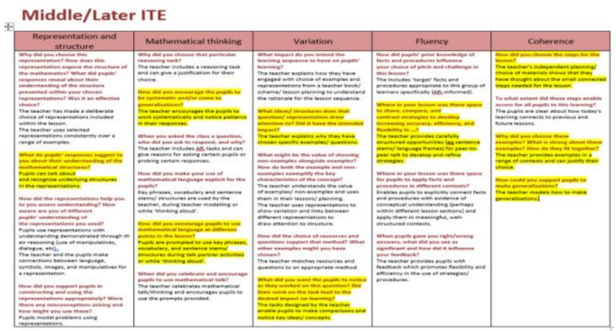
Dr. Vivien Townsend *Leicester and Leicestershire SCITT*

I first introduced the document to my Primary with Mathematics PGCE students in December. By this point of the course, we had talked in some depth about the NCETM's *5 Big Ideas of Teaching for Mastery* and they were able to see how the document would support their reflection on practice in their forthcoming placements. We talked about the structure of the document and I also shared it with their mentors for their Spring term placements. During the summer term, when I visited each student and observed them teaching maths, I modelled the use of the document to their mentors, choosing questions that were relevant to the lesson observed. I used the Middle/Later ITE summary page, finding the questions very helpful to probe the students' thinking at a deep level. Students confirmed that this is a useful document for their reflection on practice.

Dr Alison Godfrey, *University of Leicester*

Context : a maths session with BA Hons (QTS) students in their third year of study. The session followed placement and was their final session of the course.

Session outline: students were reminded of the *Five Big Ideas of Mastery* with which they are already familiar. They were given the single page handout for middle/ later ITE and given time to read it. The tutors then walked them through a lesson which had been delivered by a local mastery specialist and which the tutors had observed. The accompanying PowerPoint showed slides which the teacher had used and work which the pupils had produced during the lesson. At various times, the tutor prompted the students to consider the reasons for specific teacher choices e.g. choice of tasks, sequence of tasks, choice of examples, purpose of sentence stems etc. making links with the *5 Big Ideas*. Students then returned to the prompt sheet and considered how the teacher might answer specific questions – highlighted below.


Middle/Later ITE

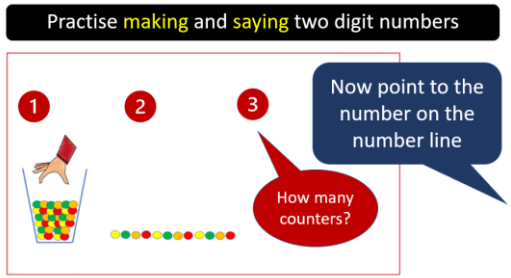
Representation and structure	Mathematical thinking	Variation	Fluency	Coherence
Why did you choose this representation? How does this representation expose the structure of the mathematics? What did pupils' responses reveal about their understanding of the structure presented within your chosen representations? Was it an effective choice? The teacher has made a deliberate choice of representations included within the lesson. The teacher uses selected representations consistently over a range of examples. What do pupils' responses suggest to you about their understanding of the mathematical structures? Pupils can talk about and recognize underlying structures in the representations. How did the representations help you to you assess understanding? How aware are you of different pupils' understanding of the representations you used? Pupils use representations with understanding demonstrated through their reasoning (use of manipulatives, dialogue, etc). The teacher and the pupils make connections between language, symbols, images, and manipulatives for a representation. How did you support pupils in constructing and using the representations appropriately? Were there any misconceptions arising and how might you use these? Pupils model problems using representations.	Why did you choose that particular reasoning task? The teacher includes a reasoning task and can give a justification for their choice. How did you encourage the pupils to be systematic and/or come to generalisations? The teacher encourages the pupils to work systematically and notice patterns in their responses. When you asked the class a question, who did you ask to respond, and why? The teacher includes AfL tasks and can give reasons for asking certain pupils or probing certain responses. How did you make your use of mathematical language explicit for the pupils? Key phrases, vocabulary and sentence stems/ structures are used by the teacher, during teacher modelling or while 'thinking aloud'. How did you encourage pupils to use mathematical language at different points in the lesson? Pupils are prompted to use key phrases, vocabulary, and sentence stems/ structures during talk partner activities or while 'thinking aloud'. When did you celebrate and encourage pupils to use mathematical talk? The teacher celebrates mathematical talk/thinking and encourages pupils to use the prompts provided.	What impact do you intend the learning sequence to have on pupils' learning? The teacher explains how they have engaged with choice of examples and representations from a teacher book/ scheme/ lesson planning to understand the rationale for the lesson sequence. What ideas/ structures does that question/ representation draw attention to? Did it have the intended impact? The teacher explains why they have chosen specific examples/ questions. What might be the value of showing non-examples alongside examples? How do both the example and non-examples exemplify the key characteristics of the concept? The teacher understands the value of examples/ non-examples and uses them in their lessons/ planning. The teacher uses representations to show variation and links between different representations to draw attention to structure. How did the choice of resources and questions support that method? What other examples might you have chosen? The teacher matches resources and questions to an appropriate method. What did you want the pupils to notice as they worked on this question? Did their work on the task lead to the desired impact on learning? The tasks designed by the teacher enable pupils to make comparisons and notice key ideas/ concepts.	How did pupils' prior knowledge of facts and procedures influence your choice of pitch and challenge in this lesson? The includes 'target' facts and procedures appropriate to this group of learners specifically (AfL-informed). Where in your lesson was there space to share, compare, and contrast strategies to develop increasing accuracy, efficiency, and flexibility in ...? The teacher provides carefully structured opportunities (eg sentence stems/ language frames) for peer-to-peer talk to develop and refine strategies. Where in your lesson was there space for pupils to apply facts and procedures in different contexts? Enables pupils to explicitly connect facts and procedures with evidence of conceptual understanding (perhaps within different lesson sections) and apply them in meaningful, well-structured contexts. When pupils gave you right/wrong answers, what did you see as significant and how did it influence your feedback? The teacher provides pupils with feedback which promotes flexibility and efficiency in the use of strategies/ procedures.	How did you choose the steps for the lesson? The teacher's independent planning/ choice of materials shows that they have thought about the small connected steps needed for the lesson. To what extent did these steps enable access for all pupils to this learning? The pupils are clear about how today's learning connects to previous and future lessons. Why did you choose these examples? What is strong about these examples? How do they fit together? The teacher provides examples in a range of contexts and can justify their choice. How could you support pupils to make generalisations? The teacher models how to make generalisations.

Other questions were then considered. For example, the lesson did not make use of concrete or visual representations so students were asked to consider what might have been appropriate ones to choose and to discuss the benefits and drawbacks. Some examples were then provided and discussed, and links made to the NCETM materials. Finally, they were asked to consider *coherence* by suggesting what the focus of the next lesson might be. Again, links were made to the PD materials.

Following this, students were asked to look at one of their own lesson plans from the recent placement and answer some of the questions from the sheet with a partner. This was designed to support their lesson reflection. All students left with a reference copy of the sheet and were encouraged to use it in their lesson planning and reflections for their next placement.

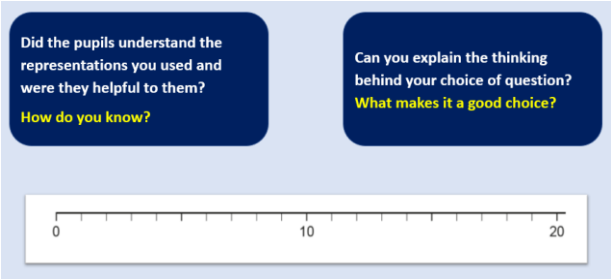
Laura Malpas *Nottingham Trent University*

When I shared the document with our University Link tutors (visiting tutors) I began by helping them to navigate the document. I then shared an example of a situation where a student teacher at an early stage of development was beginning to use representations to support learning:

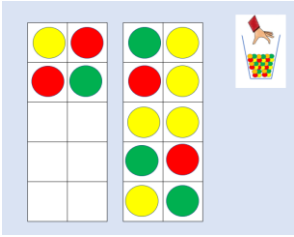


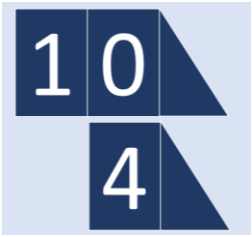
Colleagues were encouraged to consider how specific *Questions and Prompts* could have been used to support the student teacher to:

- reflect on the effectiveness of their chosen representations for exposing mathematical structure
- consider the importance of careful choice of examples



We then considered those prompts as a springboard for evaluating other possibilities with the student teacher:





Deliah Pawluch *Nottingham Trent University*

The Pilot *Primary Questions and Prompts* document was shared with me to support me as a school-based ITT mentor. In the early stages of working with the trainee, the document helped us conduct an initial needs analysis, identifying aspects of the 'Early-Middle' prompts the student wanted to explore. It provided practical targets for him, embedded within the TfM principles. For example, in the early stages it was decided that the student would investigate the principle of mathematical thinking in more detail, looking to action this aspect:

> "the teacher includes a task or prompt that encourages reasoning (e.g. 'same and different' or 'always sometimes never true')."
>
> *Mathematical Thinking – Early-Middle ITE*

This impacted the student's questioning; he created scenarios based on 'always, sometimes, never true' questions for his work with a small group of children. During post-learning discussions, it was clear that the next step for this trainee would be to consider his justification for his choice of examples. This document was fantastic at providing us with measurable and actionable targets and for me it is clear how it is progressive along the professional learning journey of a trainee.

Rebekah Gear (Maths Lead and ITE Mentor)

Hillocks Primary Academy

Representation and structure

	Early/ Middle ITE	Middle/Later ITE	Later ITE/ECT
Choice of representation	**Why did you choose this representation? How familiar are the pupils with it? What did you need to do to support their understanding of it? What do the pupils' responses suggest about how this representation supported their understanding?** The teacher has actively chosen the representations included within the lesson.	**Why did you choose this representation? How does this representation expose the structure of the mathematics? What did pupils' responses reveal about their understanding of the structure presented within your chosen representations? Was it an effective choice?** The teacher has made a deliberate choice of representations included within the lesson. The teacher uses selected representations consistently over a range of examples.	**Why did you choose this representation? What do pupils' responses reveal about the connections they are making across concepts and their understanding of relationships?** The teacher has made a deliberate choice of representations across lessons/topics with regular use and access for pupils.
Pupil understanding of representations and structures	**What mathematical structures were you hoping to draw the pupils' attention to?** The teacher draws attention to pattern and structure within the representation.	**What do pupils' responses suggest to you about their understanding of the mathematical structures?** Pupils can talk about and recognise underlying structures in the representations.	**How did your teaching choices support pupils in making mathematical connections between representations? How does this support their deeper understanding of the mathematical structures? How is this moving them towards more abstract thinking?** Pupils make connections between different representations and make choices about representations, showing understanding of underlying structures. This supports their understanding of the symbolic.
	Did the pupils understand the representations you used and were they helpful to them? How do you know? Pupils use teacher demonstrated representations to solve problems posed by the teacher.	**How did the representations help you to you assess understanding? How aware are you of different pupils' understanding of the representations you used?** Pupils use representations with understanding demonstrated through their reasoning (use of manipulatives, dialogue, etc). The teacher and the pupils make connections between language, symbols, images, and manipulatives for a representation.	
	How did your teacher modelling support pupils' understandings of the representations? … of the mathematics? The teacher models problems using representations.	**How did you support pupils in constructing and using the representations appropriately? Were there any misconceptions arising and how might you use these?** Pupils model problems using representations.	**How did your questioning prompt pupils to use the representations to reason more deeply about mathematics?** Both the teacher and the pupils actively compare and contrast representations to deepen thinking.

Mathematical thinking

	Early/ Middle ITE	Middle/Later ITE	Later ITE/ECT
Teacher includes reasoning tasks and asks questions	**What opportunities did you provide for pupils to reason?** The teacher includes a reasoning task (e.g. 'same and different' or 'always sometimes never true').	**Why did you choose that particular reasoning task?** The teacher includes a reasoning task and can give a justification for their choice.	**How did that reasoning task develop pupil understanding?** The teacher has a clear rationale for a reasoning task (e.g. it draws attention to common errors and misconceptions).
	What questions did you ask to prompt mathematical thinking? The teacher asks, "what do you notice?"	**How did you encourage the pupils to be systematic and/or come to generalisations?** The teacher encourages the pupils to work systematically and notice patterns in their responses.	**How did the chosen tasks provide an opportunity for the pupils to be systematic and/or come to generalisations?** The teacher sets tasks to deliberately draw out generalisations.
	When a child gave you an answer, what follow up questions did you ask? The teacher includes AfL tasks and asks, "how do you know?"	**When you asked the class a question, who did you ask to respond, and why?** The teacher includes AfL tasks and can give reasons for asking certain pupils or probing certain responses.	**When you asked the class a question, what responses were you looking out for and how did you plan to use these?** The teacher includes AfL tasks and has a clear rationale for which pupils to ask and which responses to probe (e.g. to address common errors or misconceptions). The teacher may be looking out for specific responses and have a rationale for addressing these in a certain order so that a teaching point can be made.
Teacher and pupil mathematical talk	**What mathematical language were you using today?** The teacher uses vocabulary accurately.	**How did you make your use of mathematical language explicit for the pupils?** Key phrases, vocabulary and sentence stems/ structures are used by the teacher, during teacher modelling or while 'thinking aloud'.	**At what points did you intentionally model a high standard of mathematical language?** The teacher models high quality explanations and justifications.
	How did you encourage pupils to use mathematical language? Pupils are encouraged to use the vocabulary for this lesson in their responses.	**How did you encourage pupils to use mathematical language at different points in the lesson?** Pupils are prompted to use key phrases, vocabulary, and sentence stems/ structures during talk partner activities or while 'thinking aloud'.	**How did you encourage pupils to provide coherent mathematical explanations and justifications?** Pupils respond to the teacher and each other using a high standard of mathematical talk including in explanations and justifications.
	When did you celebrate mathematical talk? The teacher celebrates mathematical talk/thinking.	**When did you celebrate and encourage pupils to use mathematical talk?** The teacher celebrates mathematical talk/thinking and encourages pupils to use the prompts provided.	**When did you celebrate and improve pupils' mathematical talk?** The teacher celebrates mathematical talk/thinking and supports pupils to improve their contributions.

Variation

	Early/ Middle ITE	Middle/Later ITE	Later ITE/ECT
Overall	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains how they have engaged with a teacher book/ scheme/ lesson plan to understand the rationale for the lesson.	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains how they have engaged with choice of examples and representations from a teacher book/ scheme/ lesson planning to understand the rationale for the lesson sequence.	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains the rationale for the choice of examples and representations in the lesson sequence and can justify this in terms of procedural fluency and/or conceptual understanding.
Conceptual variation	**Why were these representations selected?** The teacher uses a range of representations to deepen pupils' understanding.	**What ideas/ structures does that question/ representation draw attention to? Did it have the intended impact?** The teacher explains why they have chosen specific examples/ questions. **What might be the value of showing non-examples alongside examples? How do both the example and non-examples exemplify the key characteristics of the concept?** The teacher understands the value of examples/ non-examples and uses them in their lessons/ planning. The teacher uses representations to show variation and links between different representations to draw attention to structure.	**What else could you have changed or kept the same? What impact might this have had on pupils' learning?** The teacher uses carefully structured questions/ representations/ tasks to enable pupils to draw attention to structure. **As a result of their generalising, what mathematical structure can pupils now understand and use? What 'next steps' are needed to consolidate and deepen their understanding?** The teacher uses carefully structured questions/ representations/ tasks to enable pupils to make generalisations.
	What resources might best support different methods? The teacher recognises that there are several calculation methods available and that pupils can use different methods.	**How did the choice of resources and questions support that method? What other examples might you have chosen?** The teacher matches resources and questions to an appropriate method.	**How might you support pupils in choosing the most appropriate method / resource?** The teacher chooses resources and questions to explore efficiency of different methods.
Procedural variation	**Can you explain the thinking behind your choice of question? What makes it a good choice?** The teacher has a rationale for their choice of tasks. **Why does this question come before the next one in your teaching sequence?** The teacher can identify connections between different questions/ tasks and explain why this is an appropriate sequence.	**What did you want the pupils to notice as they worked on this question? Did their work on the task lead to the desired impact on learning?** The tasks designed by the teacher enable pupils to make comparisons and notice key ideas/ concepts.	**What misconceptions did you identify or anticipate prior to the lesson? How did you frame specific questions to help you to address specific misconceptions?** The teacher has designed tasks that draw attention to misconceptions.

Fluency

	Early/ Middle ITE	Middle/Later ITE	Later ITE/ECT
Knowledge of facts and procedures	**What facts and procedures did the pupils need to know to access learning in this lesson?** The teacher includes facts and procedures appropriate to the age range (broadly matched to school policy or NC).	**How did pupils' prior knowledge of facts and procedures influence your choice of pitch and challenge in this lesson?** The includes 'target' facts and procedures appropriate to this group of learners specifically (AfL-informed).	**How did you respond in the moment if a child didn't know the facts and procedures that you'd anticipated?** The teacher provides challenge/ support based on good awareness of (individual) learners' prior learning and depth of understanding (matched to the facts and procedures required throughout the lesson).
Working accurately, efficiently, and flexibly	**Where in your lesson was there space to develop increasing accuracy, efficiency, and flexibility in …?** The teacher provides opportunities for peer-to-peer talk to share and compare strategies.	**Where in your lesson was there space to share, compare, and contrast strategies to develop increasing accuracy, efficiency, and flexibility in …?** The teacher provides carefully structured opportunities (eg sentence stems/ language frames) for peer-to-peer talk to develop and refine strategies.	**Where in your lesson did you foster pupils' capacity for working accurately, efficiently, and flexibly in …?** The teacher provides opportunities for peer-to-peer talk to reason about and evaluate strategies.
Application of facts and procedures	**Where in your lesson was there space for pupils to apply facts and procedures?** The teacher enables pupils to make use of 'familiar' facts and procedures in a range of contexts through carefully considered task design. The teacher makes some connections to supporting pupils' conceptual understanding.	**Where in your lesson was there space for pupils to apply facts and procedures in different contexts?** Enables pupils to explicitly connect facts and procedures with evidence of conceptual understanding (perhaps within different lesson sections) and apply them in meaningful, well-structured contexts.	**Where in your lesson was there space for pupils to make choices about which facts and procedures were needed in different contexts?** The teacher enables pupils to make and evaluate choices when applying facts and procedures in a variety of contexts; facts and procedures are explicitly linked with/ underpinned by conceptual understanding.
What do we value?	**When the pupils gave you right/wrong answers, how did you respond?** The teacher recognizes the need to use pupils' developing strategies/ procedures/ representations to support increasing flexibility and efficiency.	**When pupils gave you right/wrong answers, what did you see as significant and how did it influence your feedback?** The teacher provides pupils with feedback which promotes flexibility and efficiency in the use of strategies/ procedures.	**When pupils gave you right/wrong answers, how did you use their responses to promote fluency?** The teacher makes use of incorrect/ partially formed/ accurate responses to develop pupils' flexibility and understanding.

Coherence

	Early/ Middle ITE	Middle/Later ITE	Later ITE/ECT
Sequence of learning	**How do the different parts of the lesson fit together?** The teacher uses existing materials and/or planning with understanding of how they fit together.	**How did you choose the steps for the lesson?** The teacher's independent planning/ choice of materials shows that they have thought about the small connected steps needed for the lesson.	**How was the concept developed in this lesson? In the sequence?** The teacher articulates the logical progression of the concept, within the individual lesson and as part of a sequence of lessons.
	What is the next step for these pupils? The teacher articulates the connections between different steps/ parts/ stages of the lesson.	**To what extent did these steps enable access for all pupils to this learning?** The pupils are clear about how today's learning connects to previous and future lessons.	**How could the steps be adapted for pupils who did not fully access the learning? Where does this learning fit in to the bigger picture?** The teacher is aware of the need for wider coherence and explains how the lesson connects to other topics/ subjects.
Examples and generalisations	**Why do you think these examples were chosen? What is strong about these examples? How do they fit together?** Examples are well-chosen by the teacher and support their explanations.	**Why did you choose these examples? What is strong about these examples? How do they fit together?** The teacher provides examples in a range of contexts and can justify their choice.	**How did the application of the concept/method help develop pupils' understanding?** The pupils have opportunity to apply the concept in a range of contexts.
	What generalisations can be made about this concept? The teacher recognises generalisable features in the mathematics	**How could you support pupils to make generalisations?** The teacher models how to make generalisations.	**How could pupils use the generalisations in future learning?** Lessons are designed so that pupils make generalisations which can be revisited later.

Early/ Middle ITE

Representation and structure	Mathematical thinking	Variation	Fluency	Coherence
Why did you choose this representation? How familiar are the pupils with it? What did you need to do to support their understanding of it? What do the pupils' responses suggest about how this representation supported their understanding? The teacher has actively chosen the representations included within the lesson. **What mathematical structures were you hoping to draw the pupils' attention to?** The teacher draws attention to pattern and structure within the representation. **Did the pupils understand the representations you used and were they helpful to them? How do you know?** Pupils use teacher demonstrated representations to solve problems posed by the teacher. **How did your teacher modelling support pupils' understandings of the representations? … of the mathematics?** The teacher models problems using representations.	**What opportunities did you provide for pupils to reason?** The teacher includes a reasoning task (e.g. 'same and different' or 'always sometimes never true'). **What questions did you ask to prompt mathematical thinking?** The teacher asks, "what do you notice?" **When a child gave you an answer, what follow up questions did you ask?** The teacher includes AfL tasks and asks, "how do you know?" **What mathematical language were you using today?** The teacher uses vocabulary accurately. **How did you encourage pupils to use mathematical language?** Pupils are encouraged to use the vocabulary for this lesson in their responses. **When did you celebrate mathematical talk?** The teacher celebrates mathematical talk/thinking.	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains how they have engaged with a teacher book/ scheme/ lesson plan to understand the rationale for the lesson. **Why were these representations selected?** The teacher uses a range of representations to deepen pupils' understanding. **What resources might best support different methods?** The teacher recognises that there are several calculation methods available and that pupils can use different methods. **Can you explain the thinking behind your choice of question? What makes it a good choice?** The teacher has a rationale for their choice of tasks. **Why does this question come before the next one in your teaching sequence?** The teacher can identify connections between different questions/ tasks and explain why this is an appropriate sequence.	**What facts and procedures did the pupils need to know to access learning in this lesson?** The teacher includes facts and procedures appropriate to the age range (broadly matched to school policy or NC). **Where in your lesson was there space to develop increasing accuracy, efficiency, and flexibility in …?** The teacher provides opportunities for peer-to-peer talk to share and compare strategies. **Where in your lesson was there space for pupils to apply facts and procedures?** The teacher enables pupils to make use of 'familiar' facts and procedures in a range of contexts through carefully considered task design. The teacher makes some connections to supporting pupils' conceptual understanding. **When the pupils gave you right/wrong answers, how did you respond?** The teacher recognizes the need to use pupils' developing strategies/ procedures/ representations to support increasing flexibility and efficiency.	**How do the different parts of the lesson fit together?** The teacher uses existing materials and/or planning with understanding of how they fit together. **What is the next step for these pupils?** The teacher articulates the connections between different steps/ parts/ stages of the lesson. **Why do you think these examples were chosen? What is strong about these examples? How do they fit together?** Examples are well-chosen by the teacher and support their explanations. **What generalisations can be made about this concept?** The teacher recognises generalisable features in the mathematics

Middle/Later ITE

Representation and structure	Mathematical thinking	Variation	Fluency	Coherence
Why did you choose this representation? How does this representation expose the structure of the mathematics? What did pupils' responses reveal about their understanding of the structure presented within your chosen representations? Was it an effective choice? The teacher has made a deliberate choice of representations included within the lesson. The teacher uses selected representations consistently over a range of examples. **What do pupils' responses suggest to you about their understanding of the mathematical structures?** Pupils can talk about and recognise underlying structures in the representations. **How did the representations help you to you assess understanding? How aware are you of different pupils' understanding of the representations you used?** Pupils use representations with understanding demonstrated through their reasoning (use of manipulatives, dialogue, etc) . The teacher and the pupils make connections between language, symbols, images, and manipulatives for a representation. **How did you support pupils in constructing and using the representations appropriately? Were there any misconceptions arising and how might you use these?** Pupils model problems using representations.	**Why did you choose that particular reasoning task?** The teacher includes a reasoning task and can give a justification for their choice. **How did you encourage the pupils to be systematic and/or come to generalisations?** The teacher encourages the pupils to work systematically and notice patterns in their responses. **When you asked the class a question, who did you ask to respond, and why?** The teacher includes AfL tasks and can give reasons for asking certain pupils or probing certain responses. **How did you make your use of mathematical language explicit for the pupils?** Key phrases, vocabulary and sentence stems/ structures are used by the teacher, during teacher modelling or while 'thinking aloud'. **How did you encourage pupils to use mathematical language at different points in the lesson?** Pupils are prompted to use key phrases, vocabulary, and sentence stems/ structures during talk partner activities or while 'thinking aloud'. **When did you celebrate and encourage pupils to use mathematical talk?** The teacher celebrates mathematical talk/thinking and encourages pupils to use the prompts provided.	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains how they have engaged with choice of examples and representations from a teacher book/ scheme/ lesson planning to understand the rationale for the lesson sequence. **What ideas/ structures does that question/ representation draw attention to? Did it have the intended impact?** The teacher explains why they have chosen specific examples/ questions. **What might be the value of showing non-examples alongside examples? How do both the example and non-examples exemplify the key characteristics of the concept?** The teacher understands the value of examples/ non-examples and uses them in their lessons/ planning. The teacher uses representations to show variation and links between different representations to draw attention to structure. **How did the choice of resources and questions support that method? What other examples might you have chosen?** The teacher matches resources and questions to an appropriate method. **What did you want the pupils to notice as they worked on this question? Did their work on the task lead to the desired impact on learning?** The tasks designed by the teacher enable pupils to make comparisons and notice key ideas/ concepts.	**How did pupils' prior knowledge of facts and procedures influence your choice of pitch and challenge in this lesson?** The includes 'target' facts and procedures appropriate to this group of learners specifically (AfL-informed). **Where in your lesson was there space to share, compare, and contrast strategies to develop increasing accuracy, efficiency, and flexibility in …?** The teacher provides carefully structured opportunities (eg sentence stems/ language frames) for peer-to-peer talk to develop and refine strategies. **Where in your lesson was there space for pupils to apply facts and procedures in different contexts?** Enables pupils to explicitly connect facts and procedures with evidence of conceptual understanding (perhaps within different lesson sections) and apply them in meaningful, well-structured contexts. **When pupils gave you right/wrong answers, what did you see as significant and how did it influence your feedback?** The teacher provides pupils with feedback which promotes flexibility and efficiency in the use of strategies/ procedures.	**How did you choose the steps for the lesson?** The teacher's independent planning/ choice of materials shows that they have thought about the small connected steps needed for the lesson. **To what extent did these steps enable access for all pupils to this learning?** The pupils are clear about how today's learning connects to previous and future lessons. **Why did you choose these examples? What is strong about these examples? How do they fit together?** The teacher provides examples in a range of contexts and can justify their choice. **How could you support pupils to make generalisations?** The teacher models how to make generalisations.

Later ITE/ECT

Representation and structure	Mathematical thinking	Variation	Fluency	Coherence
Why did you choose this representation? What do pupils' responses reveal about the connections they are making across concepts and their understanding of relationships? The teacher has made a deliberate choice of representations across lessons/topics with regular use and access for pupils. **How did your teaching choices support pupils in making mathematical connections between representations? How does this support their deeper understanding of the mathematical structures? How is this moving them towards more abstract thinking?** Pupils make connections between different representations and make choices about representations, showing understanding of underlying structures. This supports their understanding of the symbolic. **How did your questioning prompt pupils to use the representations to reason more deeply about mathematics?** Both the teacher and the pupils actively compare and contrast representations to deepen thinking.	**How did that reasoning task develop pupil understanding?** The teacher has a clear rationale for a reasoning task (e.g. it draws attention to common errors and misconceptions). **How did the chosen tasks provide an opportunity for the pupils to be systematic and/or come to generalisations?** The teacher sets tasks to deliberately draw out generalisations. **When you asked the class a question, what responses were you looking out for and how did you plan to use these?** The teacher includes AfL tasks and has a clear rationale for which pupils to ask and which responses to probe (e.g. to address common errors or misconceptions). The teacher may be looking out for specific responses and have a rationale for addressing these in a certain order so that a teaching point can be made. **At what points did you intentionally model a high standard of mathematical language?** The teacher models high quality explanations and justifications. **How did you encourage pupils to provide coherent mathematical explanations and justifications?** Pupils respond to the teacher and each other using a high standard of mathematical talk including in explanations and justifications. **When did you celebrate and improve pupils' mathematical talk?** The teacher celebrates mathematical talk/thinking and supports pupils to improve their contributions.	**What impact do you intend the learning sequence to have on pupils' learning?** The teacher explains the rationale for the choice of examples and representations in the lesson sequence and can justify this in terms of procedural fluency and/or conceptual understanding. **What else could you have changed or kept the same? What impact might this have had on pupils' learning?** The teacher uses carefully structured questions/ representations/ tasks to enable pupils to draw attention to structure . **As a result of their generalising, what mathematical structure can pupils now understand and use? What 'next steps' are needed to consolidate and deepen their understanding?** The teacher uses carefully structured questions/ representations/ tasks to enable pupils to make generalisations . **How might you support pupils in choosing the most appropriate method / resource?** The teacher chooses resources and questions to explore efficiency of different methods. **What misconceptions did you identify or anticipate prior to the lesson? How did you frame specific questions to help you to address specific misconceptions?** The teacher has designed tasks that draw attention to misconceptions.	**How did you respond in the moment if a child didn't know the facts and procedures that you'd anticipated?** The teacher provides challenge/ support based on good awareness of (individual) learners' prior learning and depth of understanding (matched to the facts and procedures required throughout the lesson). **Where in your lesson did you foster pupils' capacity for working accurately, efficiently, and flexibly in …?** The teacher provides opportunities for peer-to-peer talk to reason about and evaluate strategies. **Where in your lesson was there space for pupils to make choices about which facts and procedures were needed in different contexts?** The teacher enables pupils to make and evaluate choices when applying facts and procedures in a variety of contexts; facts and procedures are explicitly linked with/ underpinned by conceptual understanding. **When pupils gave you right/wrong answers, how did you use their responses to promote fluency?** The teacher makes use of incorrect/ partially formed/ accurate responses to develop pupils' flexibility and understanding.	**How was the concept developed in this lesson? In the sequence?** The teacher articulates the logical progression of the concept, within the individual lesson and as part of a sequence of lessons. **How could the steps be adapted for pupils who did not fully access the learning? Where does this learning fit in to the bigger picture?** The teacher is aware of the need for wider coherence and explains how the lesson connects to other topics/ subjects. **How did the application of the concept/method help develop pupils' understanding?** The pupils have opportunity to apply the concept in a range of contexts. **How could pupils use the generalisations in future learning?** Lessons are designed so that pupils make generalisations which can be revisited later.

Notes