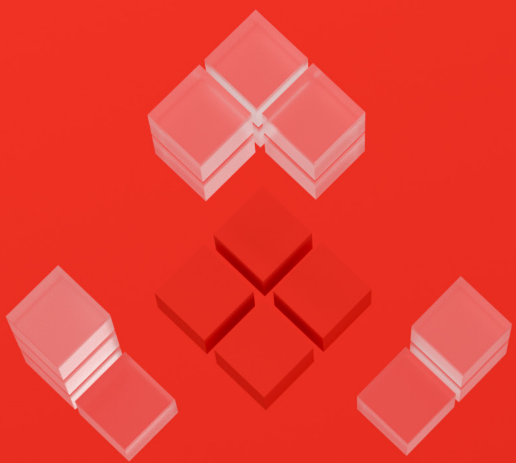
01

Understanding the Content



Great teachers understand the content they are teaching and how it is learnt

This means teachers should have deep and fluent knowledge and flexible understanding of the content they are teaching and how it is learnt, including its inherent dependencies. They should have an explicit repertoire of well-crafted explanations, examples and tasks for each topic they teach.

Summary of Dimension 1

1.1 Having deep and fluent knowledge and flexible understanding of the content you are teaching

1.2 Knowledge of the requirements of curriculum sequencing and dependencies in relation to the content and ideas you are teaching

1.3 Knowledge of relevant curriculum tasks, assessments and activities, their diagnostic and didactic potential; being able to generate varied explanations and multiple representations/analogies/examples for the ideas you are teaching

1.4 Knowledge of common student strategies, misconceptions and sticking points in relation to the content you are teaching

Elements of Dimension 1

1

The first element of Dimension 1 is essentially content knowledge, of a deep and connected kind. Teachers need to know how different ideas in the subject or domain are related, similar, sequential, analogous or distinct. They need to have thought about, and have good answers to, the kinds of 'Why?' and 'What would happen if...?' questions that students may ask and that teachers themselves should ask to promote connected and higher-order thinking. They should be able to solve the kinds of problems they must help students to solve, and to produce model answers that exhibit the skills and knowledge they need their students to learn, without errors. We might also include, under the heading of **content knowledge**, teachers' theoretical knowledge of the domain of learning. An example would be the requirement for teachers of reading to understand morphology, "the ways in which morphemes communicate meaning and govern spelling construction" (Castles et al., 2018). This requires more than just being able to read well themselves, but also to know about the fundamental anatomy of the reading process.

Content knowledge:
A teacher's knowledge and understanding of the subject(s)

2

A second aspect moves us from what is usually classified as 'content knowledge' (CK) to '**pedagogical content knowledge**' (PCK). This distinction was originally made by Shulman (1986; see also Ball et al., 2008), though a range of different interpretations of PCK have since been offered. This aspect of PCK involves knowing and being able to explain the dependencies and connections among different parts of the curriculum, and hence the requirements for sequencing. If you want students to learn a specific topic, what knowledge and skills must they have already to enable this new learning? If a student is struggling with a particular idea or technique, what kinds of gaps in underpinning knowledge might be the explanation? For each new idea, what connections do learners need to make with previous knowledge? This kind of teacher curriculum knowledge is exemplified in curriculum planning, schemes of work and lesson plans that depend on correct sequencing and planned reactivation of prior knowledge.

Pedagogical content knowledge:
While it has various nuanced definitions, the key idea to pedagogical content knowledge is that it is more than just knowledge about the content itself, but the learning associated with that particular content. PCK and content knowledge are included in separate elements, emphasing the difference between the two.

3

Didactic:

A didactic task is one in which information is explicitly transferred to a learner.

The third element of this dimension is knowledge of curriculum tasks and activities, and of standard explanations, models, analogies, representations and examples to explain and convey hard ideas. Expertise in teaching a particular topic requires having a repertoire of appropriate activities, but in particular, understanding "the **didactic** and diagnostic potential of tasks, their cognitive demands and the prior knowledge they implicitly require" (Baumert & Kunter, 2013). Expert teachers are readily able to generate or select learning activities that are appropriate for the level of challenge required or that elicit diagnostic information about learners' thinking. As with all these elements of content knowledge, this expertise is likely to be very topic-specific: the same geography teacher may be easily able to identify great resources for teaching map skills, but have a much less rich repertoire for glaciation, for example.

Direct instruction:

Direct instruction has taken on many meanings. In this particular example, it refers to a particular programme of specific, generally scripted, practices.

For each topic they teach, great teachers will have learnt effective ways of presenting the ideas: explanations that students get. In the classic **direct instruction** model (Adams & Engelmann, 1996), for example, these explanations are carefully refined and scripted, on the grounds that an individual teacher's own spontaneous explanation is unlikely to be as good as a high-quality scripted presentation.

In presenting abstract ideas, great teachers use analogies, models and representations to help learners visualise the concepts and relate them to what they already know. For example, the ball and stick model in chemistry represents molecules in a concrete, visual way that facilitates understanding of why atoms bond in particular ways. It is an effective way to introduce the ideas, but of course is not actually true, and has to be revised as students' understanding becomes more advanced. Another example would be the use of manipulatives and representations in teaching early mathematics (EEF, 2020), which can be effective in helping children to engage with and understand abstract ideas about number. Selecting good examples and non-examples (e.g., using the Frayer Model[1]) is another way of making new vocabulary or abstract ideas concrete. However, even with the best explanation, some students still may not get it. Teachers need to have more than one way of explaining or presenting the idea, and multiple examples and non-examples (ideally tailored to the student's particular misconception or gap), so that they can keep going until the student does get it.

The key point about these explanations, models, analogies, representations and examples is that they form part of the teacher's pedagogical content knowledge. In many systems, teachers are expected to learn these on the job, through trial and error, experience, intuition and *ad hoc* sharing. But this knowledge can also be explicitly taught. Great teachers also have access to great materials, rather than being expected to search for or create their own.[2]

1 For example, see Alex Quigley's blog on using the Frayer Model to teach vocabulary: **https://www.theconfidentteacher.com/2018/04/vocabulary-knowledge-and-the-frayer-model/**

2 An example from the US is **edreports.org**, which provides evidence-based reviews of textbooks and instructional materials.

4 Our fourth and final element is a knowledge of student thinking and, in particular, the misconceptions, typical errors and types of strategies students exhibit. Student misconceptions around particular ideas are predictable and inevitable. Great teachers design their presentations and learning activities to anticipate and address these misconceptions directly and explicitly, both by exposing and challenging the misconception and by presenting the correct conception clearly and directly.

A final point to note for all these aspects of teachers' understanding of curriculum content is that they are very much necessary but not sufficient for effective practice. Knowing students' likely misconceptions has no benefit unless lessons and delivery are structured to address them; having a repertoire of good examples is only useful if they are employed appropriately. In general, pedagogical content knowledge (PCK) should be learnt and deployed in the context of classroom practice: theoretical knowledge alone is not enough. This may be one of the reasons that evaluations of the impact on student learning of attempts to increase teachers' PCK have sometimes had disappointing results. It is certainly possible that we could have placed some of these elements in Dimension 4, which is concerned with teachers' classroom practices to activate student thinking: for example, 'having multiple explanations, examples, etc.' has considerable overlap with 'explaining' (Element 2 of Dimension 4, below) which is about actually using these explanations and examples effectively.

Evidence for Dimension 1

The evidence for the importance of 'pure' content knowledge is a bit mixed and conceptually somewhat confused. Many studies that have looked for relationships between teachers' qualifications or advanced subject knowledge and learning gains have failed to find them consistently (Wayne & Youngs, 2003). Nevertheless, plenty of studies have shown that measures of teachers' knowledge and conceptual understanding of the specific content they are teaching do have some predictive power for their students' learning (Baumert et al., 2010; Hill et al., 2005; Hill & Charalambous, 2012; Lynch et al., 2019; Sadler et al., 2013). These relationships are generally modest-to-weak, probably non-linear and the existing evidence may be limited to particular topics, ages or subjects. For example, Hill et al. (2005) found that variation at the bottom end of their scale of 'Content Knowledge for Teaching' (CKT) was related to effectiveness, but for the majority of teachers, whose content knowledge was at least adequate, there was no further benefit in increased CKT. There is also some evidence that training programmes designed to enhance teachers' content knowledge can lead to enhanced student learning, though again the findings are mixed (Baumert et al., 2010; Lynch et al., 2019; Timperley et al., 2007). Many of the available studies have used mathematics content, so the generalisability to other subjects is unclear, though Kaiser and König (2019) give examples of evidence from other subjects. Metzler and Woessmann (2012) provide evidence of the importance of subject knowledge for Y6 teachers in Peru.

There is broad support for the role of teachers' PCK (see Baumert et al., 2010; Kaiser & König, 2019 for reviews) though, again, much of it is from mathematics and science, and different studies operationalise PCK in different ways. A framework that specifically identifies curriculum and lesson planning-related PCK, and provides evidence of its importance, comes from the TEDS-M project (Teacher Education and Development Study in Mathematics, Blömeke et al., 2016).

"Knowledge of the didactic and diagnostic potential of tasks" is a key component of the COACTIV model of mathematics PCK (Baumert & Kunter, 2013), which was found by Baumert et al. (2010) to be a substantial predictor of student learning, after controlling for a wide range of other variables. The evidence for the importance of teachers' knowledge of good explanations, models, analogies, representations and examples in relation to the content they teach comes from the same sources cited above, for example, Baumert et al. (2010).

Being able to anticipate, identify and address student misconceptions is a feature of a number of models of teaching effectiveness (e.g., Hill et al.'s Mathematical Quality of Instruction or the Early Career Framework for England) and is supported by a range of evidence (e.g., Baumert et al., 2010; Blömeke et al., 2016; Hill et al., 2005; Hill and Chin, 2018). Understanding how 'novice' learners see the world differently from 'experts' has also been claimed as important for teachers (e.g., van Merriënboer et al., 2006), as has an understanding of how 'threshold concepts' – key ideas in a discipline that act as a portal to new ways of thinking and understanding – may either open up new insights or be 'troublesome' barriers (Meyer & Land, 2005). However, direct empirical support for the value of any specific kinds of teacher knowledge about threshold concepts is less clear. Evidence-based approaches to addressing misconceptions include challenging them or simply emphasising the 'scientific' conception (Braasch et al., 2013).