Editorial

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Abstract

There has been a huge growth in research on how to describe the kind of knowledge that teachers need since the mid-1980s when Shulman (Shulman, 1986, 1987) published his first research in this field. There is a range of ways in which to describe the field of teacher knowledge. In this editorial we aim to describe one way of mapping the field, and then place the papers in this Special Issue as well as other recent work onto this map. We do so by proposing that the propositional, the practical and the personal are different aspects of teacher learning, and that the relations between these demand more attention. We then discuss how the common categorisation of teacher knowledge can be viewed within each of these aspects, and how the key may lie in the relations as well as in the categories themselves. Finally, we reflect on the 'field' of teacher education research on the basis of the range of submissions we received. An outstanding feature of the field is its weak grammaticality, meaning that there are a range of concepts in use which do not seem to have very precise empirical descriptions (Bernstein, 1999), but this appears to vary from discipline to discipline suggesting directions for further work.

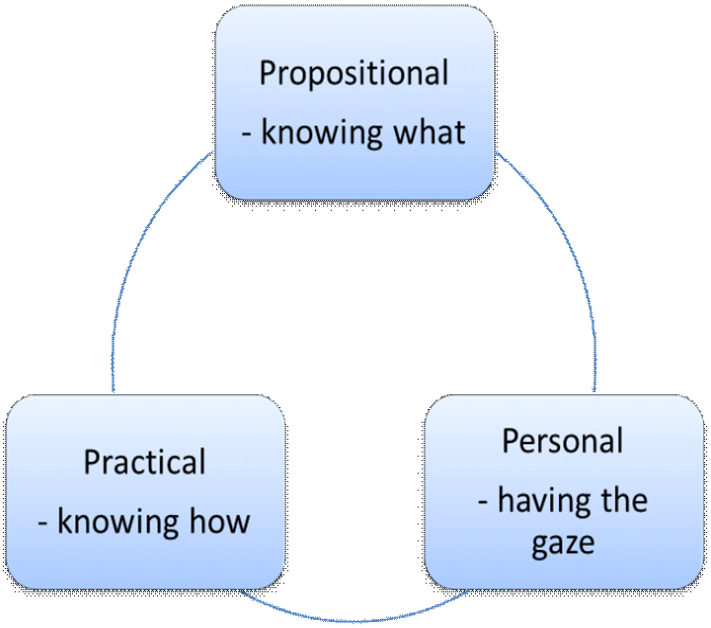
Three aspects of teacher learning: knowing, doing, being

In their attempt to map the field, Cochran-Smith and Lytle (1999) argue that there are three broad approaches to teacher learning, which they then describe (somewhat confusingly) as 'knowledges'. They refer to the first conception of teacher learning as *knowledge-for-practice* where the assumption is that researchers generate a formal body of knowledge which teachers can learn and use to improve their practice. They describe a second conception of teacher learning as *knowledge-in-practice* which is essentially practical knowledge generated by expert teachers through their own experience and practice. The third conception of teacher learning involves *knowledge-of-practice* which is the knowledge produced when teachers treat their classrooms and schools as sites of intentional investigation. It implies a critical stance to one's own practice, and thus more strongly than the other

conceptions relate to subjective theories of teaching and learning, as well as to beliefs about oneself, purposes of teaching, etc. The two latter orientations honour the idea that teachers often learn in and from practice, and not exclusively from a formally generated, codified body of knowledge. Another way of describing the kinds of knowledge that are foregrounded in these different conceptions of teacher learning is to say that knowledge-for-practice privileges propositional knowledge, codified knowledge, or knowing 'that', whereas knowledge-in-practice privileges practical knowledge or knowing 'how' (cf. Tamir, 1988). The 'knowledge-of-practice' conception seems to foreground the inquiry stance that a teacher takes, and is interested in how teacher inquiry generates knowledge, how inquiry relates to practice, and what teachers learn through inquiry. Using Maton, we could say that this orientation foregrounds a knower code or the social relation, but as Maton always says, this does not mean that the knowledge code or the epistemic relation is non-existent, since for every knowledge structure, there is also a knower structure (Maton, 2007). In line with this, we will not include perspectives on teacher learning which claims that the epistemic relation is of no relevance.

We believe that the three orientations should be seen not as mutually exclusive but rather as foregrounding different aspects of teacher knowing: the propositional, the practical and the personal. All three of these aspects are necessary in professional practice. Fischer (2011) has a different third aspect, namely conditional knowledge or 'knowing why', engaging in the project of interrogating instructional quality. We see this contained more in the concept of inference and professional judgement, which we will return to later.

Figure 1: The three aspects of teacher knowledge



A key area of engagement is the question of how the aspects relate to one another. In South Africa, the post-1994 curriculum reform and qualification frameworks foregrounded practice and what people could do (their competence) while knowledge was backgrounded. Although the Norms and Standards for Educators described foundational competence as demonstrating an understanding of the knowledge and thinking that underpins a particular action, this was often reduced to simply a 'skill'. Unfortunately, an unintended consequence of the implementation of the policy was that many teacher educators fixated on the 'seven roles of educators', and designed their teacher education curricula around the seven roles, and not around the competences which incorporate both principled knowledge and thoughtful practical knowledge (Department of Higher Education and Training, 2011). However we know that action is underpinned by thought, and that some action is more knowledgeable and thoughtful than other action (Muller, 2012). Since teaching is a professional practice, it is informed by both 'knowing what' and 'knowing how', but also by the motives, beliefs, disciplinary philosophies of the teacher (Langford and Huntley, 1999; Lloyd, 1999; Thompson, 1984). It is through engaging with the 'knowing what' and 'knowing how' of the disciplines that beliefs and disciplinary philosophies may be become more nuanced, consistent and informed – or at least conscious.

They relate, and it is in this relation that we see teacher knowledge positioned. The paper in this issue by Venkat and Askew discuss the case of teachers who were given new mathematics resources (such as an abacus) to use, but who failed to do so in a way which foregrounded key mathematical notions (in this case, the importance of focusing on the grouping into tens reflected in our number system). We could view this as the teachers lacking either the propositional mathematical or pedagogical content knowledge which could have guided their professional judgement. That is certainly a possibility, though one that Venkat and Askew reject. They propose instead that it is a consequence of absence in the sociocultural setting – the teachers have not previously encountered such uses of these resources. This illustrates how, in order to use the abacus to teach the key mathematical notions, the teachers have to have the propositional mathematical and pedagogical content knowledge, the practical knowledge of how to use resources constructively, the ability to infer from the one to the other to be able to recognise and realise the use of the new resources, and an orientation to teaching which directs them to bring this into play.

In South Africa we have perhaps – particularly in recent times – shunned the 'knowing what' because we have tended to equate it with lists of unconnected information, and have not focused sufficiently on the conceptual relations between all these facts. So we teach 'lists' rather than principles, but lists do not support the development of professional judgement. And as Ensor's work on student teachers' recontextualisation from teacher education to practice in school indicates, neither does propositional knowledge which is not linked to practice (Ensor, 2001). Thus we propose to focus on this gap that opens between the 'knowing what' and the 'knowing how' both in teacher education and as the space where research work needs to happen.

This link between the propositional and the practical, however, also draws on the particular gaze that the teacher has developed in creating an identity as a teacher, as developed in a sociocultural setting. Similarly, the link between the propositional and the practical is what helps to construct the particular trained teacher gaze that allows for recognition in practice of instances from theory, and informs professional judgement. It is this gaze which allows a teacher to recognise what counts as valid inferences in practice, drawing on knowledge for and about practice (cf. Muller, 2012). And it is this gaze which informs the teacher educator's choice of the propositional and the practical to include in teacher education.

Five domains of teacher knowledge

We move one level down from these broad perspectives to engage the five domains of teacher knowledge widely used: content knowledge, general pedagogic knowledge, pedagogical content knowledge, curriculum knowledge and knowledge of context (3 C's, GPK, and PCK!). The assumption that these are separate knowledge domains has been challenged, most recently in an Australian study of mathematics teachers' knowledge and beliefs (Beswick, Callingham and Watson, 2011), which claims that their results indicate one underlying knowledge dimension only. Nonetheless, we find the distinctions analytically useful.

Shulman has been critiqued that his categories are propositional and do not account for practical knowledge (Jones and Straker, 2006). However, in our view, all of these domains of knowledge have both propositional and procedural, as well as personal, elements.

Content knowledge embraces both the propositional knowledge/'knowing what' and the procedural knowledge/'knowing how' of a discipline. Teachers need to know more than just the 'facts' of their discipline, they need to know the deep underlying principles and structure of the discipline, and they need to know what procedures are used to generate knowledge in the field. Muller (2012) argues that 'knowing what' comes down to knowing why something is accepted as knowledge in the relevant field, but this implies knowing how to substantiate the knowledge, knowing how to make such arguments, so that all 'knowing what' also comes down to the particular 'knowing-how' of drawing inferences within the field. Coming together in a learned gaze. . . The historian does not separate looking at a particular event with an awareness of the time in which it happens and how it relates to what went before, from critically looking at the sources which provide information about the event. A mathematician does not separate knowing what the boundaries of a concept are from knowing how to use this in constructing a proof.

In the German COACTIV-study (Baumert, Blum and Neubrand, 2004; Krauss and Blum, this issue), PCK in mathematics is divided into two facets: declarative and procedural PCK. The declarative encompasses knowledge of learners' common misconceptions, knowledge of the curriculum, and predicted difficulties. The procedural includes selection of tasks, reacting to students, and assignment of homework (Olszewski, Neumann and Fischer,

2010). In some studies, the procedural PCK is explored through 'situational judgement tests' or 'teaching vignettes' (cf. Riese and Reinhold, 2010 for physics education) while others consider using it in video analysis (Olszewski, Neumann and Fischer, 2010 for physics education; Ramdhany, 2010 for mathematics education). Fischer (2011) found a correlation between declarative and procedural pedagogical knowledge of 0.20 ($p<0.01$) and thus see them as independent constructs, while Riese and Reinhold (2010) found correlations between 0.64 and 0.84 ($p<0.001$), stronger than the correlations they found between PCK and content knowledge, PCK and pedagogical knowledge, and between content knowledge and pedagogical knowledge. All these studies confirmed that content knowledge is however a prerequisite for PCK, as also suggested by the study by Beswick, Callingham and Watson (2011).

An outstanding feature of the field of teacher education is its weak grammaticality, meaning that there are a range of concepts in use which do not seem to have very precise empirical descriptions (Bernstein, 1999). As a clear example of this, every study on PCK has to operationalise the concept, and often does so in slightly different ways. This issue is critically engaged in Adler and Patahuddin's paper in this issue. Working with the notion of 'Mathematics for Teaching,' which positions itself in relation to PCK and content knowledge, they explore how carefully designed test items can facilitate teachers' talk and mathematical reasoning, leading to an exploration of knowledge connected around the teaching of specific content. Thus, their work engages both relations between knowledge domains, connections of aspects, and issues of how to address weak grammaticality in the field.

This distinction between declarative and procedural PCK becomes highly relevant when wanting to see if teachers who are able to respond well to PCK questions (which often assess what in the above distinction would be propositional PCK such as identifying learner misconceptions or levels of learner thinking) are also able to apply this knowledge in the classroom in ways which enhance learning. The paper by Krauss and Blum in this issue summarise their findings from the COACTIV project. Utilising new instruments which are open-ended rather than the oft used multiple choice approach, they explored teachers' content knowledge and PCK with practice-related vignettes, and the impact of teachers' knowledge on learners' achievements. Their findings show that content knowledge and PCK are linked to beliefs as well as practice, for us highlighting the relation between the three knowledge aspects. Their study found PCK but not content

knowledge linked to learner achievement. This does not mean that content knowledge does not matter – but it is possibly doing so only indirectly, as content knowledge is correlated with PCK (Riese and Reinhold, 2010), and appears to be a prerequisite for PCK but not implying it (Riese and Reinhold, 2010). The latter also appears to hold in South Africa, though no clear link between PCK and learner achievement was found here (Ramdhany, 2010). Finally, they found no link between number of years of experience and demonstrated PCK, but this must be seen in light of the fact that there were no novice teachers in their study.

There is, as in all professions, a very real discursive gap between the theoretical and the practical (Muller, 2012), between knowing what errors learners often make and being able to use that knowledge to make professional judgements in the classroom, between having the academic knowledge and having what Shalem (forthcoming) using Abbott's work refers to as the diagnostic knowledge (cf. Ashlock, 2002; Cooper, 2009)

> Two processes are involved in diagnostic knowledge. First, the practitioner collects information about a particular case . . . and assembles it into a complex picture, according to certain epistemic rules and criteria specific to the subject matter. Second, the practitioner takes the complex picture and refers it to diagnostic classifications that are already know to the profession and deduces the type of case in particular (Shalem, forthcoming, p.7).

In that sense, the gap Muller sees between the theoretical and the practical refers to what must be bridged in the relation between the propositional and the practical if teachers are to be able to identify real events as instances of theoretical events, and make informed strategic decisions on how to act in the situation. It means that the teachers needs a reservoir of academic knowledge – the propositional or 'knowing what' – to draw on, and it means that the link to the practical is made through inferences, which for both Muller and Shalem means that the teacher needs to 'know how' to make such inferences.

Within teacher education, this becomes very real in trying to develop assessment criteria for student teachers in their practice teaching, and the need to award a final mark to this teaching practice. As Rusznyak discusses, to base the assessment entirely on what the students do is not sufficient; if student teachers are not able to explain why they make the decisions they do and reflect on them in substantial ways, they are not empowered professionals who can make inferences on which to base professional judgements. Thus, teacher educators also need to engage with the extent to which student teachers draw on the established body of knowledge in diagnosing and

'treating' problems in the classroom – in other words, to what extent they have the propositional knowledge and can close the discursive gap to practice sufficiently well. Rusznyak draws on Shulman's important distinction between pedagogical reasoning and pedagogical practice, and describes the development of an assessment rubric that maps both the cognitive dimension of teaching, and the observable classroom performance. It is not enough that student teachers reflect on their teaching, that reflection must be informed – it must relate back to knowledge for, in and of teaching.

These issues obviously also apply to pedagogical, context and curriculum knowledge. Knowing that learners from less privileged backgrounds have problems decoding invisible pedagogies does not make it easy to adjust one's teaching accordingly. Having a sense of the possibility of a particular disciplinary domain in relation to the educational task (including the development of citizenry), and understanding the different paradigms or philosophies of the discipline as it has evolved in history, may mean reading the curriculum differently, but it still needs to be recontextualised and operationalised to be related to the learners' prerequisites and implemented in 45 minute lessons.

The links between the knowledge domains will also play out differently in different contexts. A recent study in Denmark (Lindenskov, 2012) developed materials for supplementary mathematics teaching. The materials were inspired by materials from elsewhere but had to be adopted to the Danish situation, where learners' motivation and interest are considered central, where teachers must know how to involve parents in the learning work, where the learners are not told but guided through exploring, and where the material was more about directing the teachers to what to explore in order to respond to the learners better, than about how to present. This is clearly a *knowledge-of-practice* perspective, but again we want to point to how this is informed reflection; that is why a set of materials developed by specialists is used to direct the teachers' attention to the relevant elements of the teaching-learning situation. This direction of their attention is aiming at developing a trained gaze which is strongly anchored in specialist knowledge about how children learn mathematics (see also Schifter, 1998).

A Danish teacher trained in this tradition would battle to adapt to the South African classroom, and *vice versa*. Yet we need to be able to describe the knowledge, practices and gazes/stances of teachers in both contexts using the same concepts. In our view, we can only do so through focusing on the

relations between the knowledge domains and the three aspects of teacher learning. This is supported by studies such as one by Ainley and Luntley, where they found that experienced teachers draw on what the authors call 'attention-dependent knowledge', paying attention not only to the content of learners' statements but also to the intentions of these statements (Ainley and Luntley, 2007).

Teacher education and teacher learning

There are three papers in this issue which engage the content of teacher education programmes and teacher learning specifically. It seems only logical that teacher education must have strong relations to the different aspects and domains of teacher learning. And if we are right, the relations between the aspects would also need to be engaged. For instance, the substantive or propositional within curricular knowledge can address the current curriculum as well as the principled curriculum, but linking it to the practical knowledge aspect would be where issues of how to select and sequence content comes into play (something many mathematics teachers in the Western Cape were seen to struggle with (Reeves and McAuliffe, 2012). This also shows that there are also two dimensions to the practical dimension of curricular knowledge, namely how to implement the curriculum and how to critically engage it.

Taking a more general and macro view of knowledge domains, Sosibo focuses on the kinds of knowledge domains that are prioritised in a commerce stream of a B.Ed programme. The Minimum Requirements for Teacher Education Qualifications framework stipulates five teacher knowledge domains, namely, disciplinary, general pedagogical, practical, fundamental and situational knowledge, and Sosibo uses these to cluster the data that emerged from interviews with students and teacher educators on this programme. It emerges that the programme places greatest emphasis on general pedagogical and practical knowledge, and the least emphasis on fundamental and situational knowledge. This was of concern for students who felt that they were not prepared to teach in under-resourced schools, again pointing to the gap between propositional and procedural knowledge in the various domains.

Christiansen also engages a formal teacher education programme, and considers the extent to which a PGCE programme prepares mathematics teachers to teach effectively in the local context. A key question underpinning the paper is to what extent teacher knowledge and competence have an impact on learner achievement, given the overwhelming influence of the socio-economic and home background. The paper presents an analysis of the assessment tasks of the PGCE for maths teachers, using three criteria: what knowledge domain do the tasks assess; do the tasks emphasise a knowledge code (that is, *what* you know, is important) or a knower code (*who* you are, is important); and to what extent the tasks focus on contextualised or decontextualised knowledge. She found that the programme tended to focus on the application of decontextualised content. The latter links to our concerns about being able to infer from academic knowledge to diagnostic knowledge; perhaps what is necessary is to have what Maton refers to as a semantic wave Maton (in press), moving between contextualised and decontextualised, and in the process demonstrating ways of bridging the discursive gap between theory and practice?

Interestingly, only one paper in the issue addresses the specifics of teachers developing their knowledge, practices and gazes. Bansilal's paper foregrounds the knowledge that is acquired and generated by teachers when they take an inquiry stance. She uses the narratives of four mathematics teachers who enrolled for a master's degree to show that these teacher-researchers were able to develop their knowledge for mathematics teaching as a result of their classroom inquiry. The teachers develop both propositional and practical knowledge, and the process of engaging with a systematic classroom-based inquiry seems to help them to bridge the discursive gap described earlier. This is the only paper in the volume that points to a possible process of *how* teachers may do this, and we see parallels to another South African study of how mathematics teachers learn through challenges in a context of solidarity (Brodie and Shalem, 2011).

Specialised knowledge in teacher education

Above, we have discussed what we consider different aspects and domains of teacher knowledge, and claimed that it is the relations between these that teacher knowledge comes to life, so to speak, in terms of making *informed* professional judgments or inferences through drawing on specialised

knowledge. The question is, does such specialised knowledge exist? It does, as also highlighted by Shalem, who convincingly argues that both condensing a case and characterising it, both diagnosing a problem and treating it, should draw on specialised knowledge. But the extent and coherence of this body of knowledge appears to vary from discipline to discipline. Concepts are not clearly defined in relation to the empirical (weak grammaticality), making it necessary to reiterate concepts in every study, and concepts are often not clearly related, making it difficult to determine when theories are redundant or what new a concept adds to the field. Variations in the extent to which bodies of specialised knowledge were reflected in the submissions to this special edition on teacher knowledge illustrate this.

There were twenty-one submissions, which seems to indicate a healthy interest in the field. Eight of these were in the field of mathematics education, and one in science education, while the others were more generally in the field of teacher education. This may be an indication that in South Africa at present, as worldwide, the field of mathematics and science education is more strongly focusing their research in the area of teacher knowledge, and is developing a more precise language of description to do this research. There were no submissions on teacher knowledge in the field of literacy and teaching reading, or within the social science and humanity subjects. Yet the work by Christie analysed by Shalem indicates that it is not only possible but constructive to develop specialised knowledge for the teaching of English, for instance (Christie and Macken-Horarik, 2011). And some of Maton's work may have the potential to provide concepts which can be given specialised interpretations – for instance, the work by Adler and colleagues distinguishing teacher education lectures on the basis of the legitimising appeals to specialised mathematics education knowledge or the lecturers' personal experience (Parker and Adler, 2012), could be seen as distinguishing between stressing the epistemic relation versus stressing the social relation (Maton, 2007).

This distinction was also reflected in a meta-level study, comparing teacher education programmes across four countries (Rasmussen and Bayer, 2011). Rasmussen and Bayer found no major differences in the programmes between countries with high versus low performing learners, but they did find some differences in what types of knowledge is foregrounded. Interesting to us is the distinction they made between knowledge with a scientific versus an empirical basis. Perhaps we can now think of teacher knowledge as a double storey house with an attic – teacher knowledge on one level, teacher

education on another but matching the rooms underneath, and the attic a space where issues of how to measure teacher knowledge and learning and their relations to learners' achievements and attitudes are engaged. In that sense, many of the papers in this issue span several levels; for instance, the papers by Rusznyak, Adler and Patahuddin, and Krauss and Blum all engage issues of measurement which have to relate to types of teacher knowledge in order to achieve their purpose. Or perhaps teacher knowledge is like a fairy tale house with secret passageways and mysterious staircases, which is there as a physical entity (propositional), in which people do things (procedural) and which is also a lived-in space with emotional associations (personal). Our different aspects and domains are windows into the house, yet to describe the house better, we have to be aware of how the rooms relate and how best to get from one place to the other. Teacher education may then be seen as the blue print or the plumbing and wiring of the house . . . the metaphor is there to be played with.

A couple of recent works have shown the limitations of using one language of description only to try to distinguish practices, and have promoted combining descriptions of pedagogy with descriptions of relations to knowledge. Parker and Adler (2012) shows that when looking at the type of activity in the classroom, two lessons may appear similar, but their legitimation codes reveal just how different they are in their relation to knowledge. Naidoo (2012) shows that distinguishing between visible and invisible pedagogies does not capture the conceptual depth of the lesson, for which she instead draws on the systemic functional linguistic concept of co-extensions of meaning. We welcome this increased focus on relations to knowledge combined with other aspects and domains. However, they do not yet form a more coherent perspective on teacher knowledge, practice and learning. For the languages of description in teacher education to gain stronger grammaticality and verticality, we have to find ways to describe teacher education which can span a range of contexts, and which adds to our understanding of the ways of bridging the gaps between 'knowing what,' 'knowing how,' and having the gaze of 'being' a teacher.

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