Professional Inquiry:

Promoting deep thinking across the curriculum

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Introduction

A primary aim of this project is to improve the educational experience of students across the One Cumbria community of schools. A second aim is to develop a professional learning network (PLN) to support collaborative professional development and strengthen relational resilience of teachers. A third aim of the project is to build capacity for 'professional inquiry' with experienced teachers.

Professional inquiry is an approach to teachers' professional development that borrows from collaborative teacher action research methodology. Professional Inquiry involves critically engaging with practical wisdom of teachers and relevant theory and research evidence in the process of developing a research question, systematically generating and analysing data, sharing the findings, and taking action to change practice.

The One Cumbria region includes some small primary schools in rural settings, and this means that teaching often involves managing mixed age classes. The secondary schools are generally co-educational with comprehensive intake but there is also one selective grammar school. In this professional inquiry project four of the teacher researchers are based in secondary schools, two teaching art, one geography, and one history (as a second subject). Two of the teacher researchers are based in primary schools, one teaching mixed age (years 5 and 6) science and one, in a small school, teaching a mixed age maths class but with a focus on a small group of year 5 students. All of these are experienced teachers who have previously completed a school leadership professional development programme.

Professional Inquiry

As a starting point for professional inquiry, teacher researchers reflected and identified a 'stone in their shoe' (Baumfield, Hall and Wall, 2017). By this we mean an issue that was bothering them about their students' progress in their lessons within a particular curriculum subject.

Teacher researchers considered: What lessons or sessions or workshops you have taught recently? What do you feel about the impact of your teaching? Did anyone learn anything and if so how and why? What do you think might be worth investigating about your own teaching? What is the stone in your shoe?

At a face-to-face session each of the teacher researchers in turn shared the 'stone in their shoe': their initial idea, issue, or question for inquiry. As the session progressed, we identified some common interests and worked towards a shared focus for inquiry and an emerging research question. At least two shared issues arose, one around engagement of some students, and one around language and thinking. We decided to investigate how teachers might encourage 'deep thinking' by their students within the curriculum subject they were teaching. By 'deep thinking' they meant that their learners might think through problem-solving like a mathematician, like a historian, like a geographer, like an artist, and so on. This focus on thinking is entangled with use of language and with writing within different curriculum subjects.

Developing a research question is a critical step in a professional inquiry. It is important as part of that process to critically engage with 'what works here' meaning the practical and situated wisdom of expert teachers in their school and their curriculum subject. It is also important to critically engage with relevant literature, theory, research and professional guidance; to consider that 'public knowledge' and how significant it seems to classroom practice.

The issue of 'owning' the research question is highlighted by many colleagues and small-scale studies as a critical aspect of professional inquiry. But having begun with their individual 'stone in my shoe' it also seems possible for teacher researchers to 'come to own' a research question as they collaboratively develop an inquiry, through dialogue and critical engagement with classroom practice and relevant literature. This ownership might be feasible even if the initial issue has come from colleagues or even been handed down from management, or from an external school inspector, provided the eventual research question connects to the professional purposes, values, and experiences of teacher researchers (Glenn et al., 2024; Punch and Oanacea, 2018).

Literature

Classroom teaching is complex and an issue such as promoting deep thinking has connections to many overlapping areas of literature. A concise literature review provided by the research mentor after the first cycle of data generation introduced a range of potentially relevant topics. These included: philosophy for children; epistemic quality; dialogic teaching; and facilitation of inquiry-based teaching. In addition, and in some ways bringing all of these relevant areas together, the use of the semantic dimension of Legitimation Code Theory (LCT) to analyse classroom practice, including the idea of the semantic wave of a lesson.

A philosophical perspective on deep thinking

There have been many projects that focus on practical ways to develop deep thinking in classrooms. Many of these are usefully embedded within particular curriculum subjects. An example of an influential project is 'Thinking Through Geography', led by David Leat at Newcastle University. This project began in a pragmatic way by working with teachers to develop lessons in Geography that were simply more interesting, and the research to support the approach came later. Other significant deep-thinking projects included Cognitive Acceleration in Science (CASE) and Cognitive Acceleration in Maths (CAME). The CASE and CAME projects built from a learning theory foundation to design lessons and learning activities. They involved challenging problems, collaborative learning, metacognition, and 'concrete preparation', a whole-class activity where pupils share ideas on what the task is about.

The Philosophy for Children (P4C) might be viewed as a 'transdisciplinary' approach to deep thinking in the classroom because it often deals with big societal issues but arguably it might be viewed as introducing a new subject, philosophy, to the curriculum. The P4C approach encourages pupils to ask questions, justify opinions, and challenge each other. Large-scale experimental EEF research on the impact of P4C has found it be popular with teachers and children but with little evidence of impact on national test results for example on reading levels. The underpinning thinking about thinking, as applied through the P4C approach, has been shaped by an influential and accessible text by Matthew Lipman (1991). Lipman considers higher order thinking requires both critical thinking and creative thinking and that the 'community of inquiry', '…especially when it employs dialogue, is the social context most reliable for the generation of higher-order thinking' (Lipman, 1991: 21). He argues that the classroom can be converted into a community of inquiry, '…in which students listen to one another with respect, build on one another's ideas, challenge one another to supply reasons for otherwise unsupported opinions, assist each other in drawing inferences from what has been said, and seek to identify one another's assumptions' (1991: 15).

The EEF have investigated the impact of Philosophy for Children. An initial study identified two months' progress in reading and maths. Their second evaluation study found no impact on reading and maths but teachers 'reported feeling that the programme had a positive impact on pupils' social, thinking and communication skills, and found it particularly helpful for children who were less self-confident.' The lack of evidence of impact on attainment scores means that the EEF have chosen not to pursue further research into P4C. They do note that it has no negative impact, and so schools might engage with P4C for 'non-cognitive' aims and purposes such as pupil confidence and oracy.

Epistemic quality and insight

The curriculum subject discipline is an important element of the context of classroom teaching that promotes deep thinking. Recent curriculum development focus in England has been on

knowledge and the concept of powerful knowledge (Young, 2013). But it is important to note that powerful knowledge is a contested concept, at least in the way it has been interpreted by some teachers, school inspectors, and policy-makers (Boyd,2019). Brian Hudson argues that effective teaching of knowledge in maths needs to demonstrate 'epistemic quality' (Hudson, 2019). By high epistemic quality he means that: 'This involves an approach that presents mathematics as fallible, refutable and uncertain, and which promotes critical thinking, creative reasoning, the generation of multiple solutions and of learning from errors and mistakes. In contrast, school mathematics of low epistemic quality is characterized by an approach that presents the subject as infallible, authoritarian, dogmatic, absolutist, irrefutable and certain, and also involves rules that follow strict procedures and right or wrong answers.' This definition of high epistemic quality applies to teaching maths, but it is worth considering how we might define high epistemic quality in teaching other curriculum subjects. For example, a recent study of enquiry-based teaching in primary school history was informed by the concept of epistemic quality (Hill, 2024). It includes the social realism perspective (Moore, 2013) that knowledge is developed by people, and so whilst it may, in part, be factual or 'real', it is also dynamic and contested, and arguably children need to understand that.

Dialogic teaching, Oracy and collaborative learning

In dialogic teaching the teacher designs and facilitates problem-solving tasks and negotiates rules for classroom talk with pupils (Alexander, 2020). The teacher uses modelling and coaching of the rules during collaborative buddy talk and whole class discussion. Classroom dialogic teaching relies on good levels of trust and a desire to work towards consensus, but also perhaps requires a level of challenge or even conflict. So, the rules of classroom talk include the need to diplomatically challenge the thinking of others. The rules negotiated for dialogic teaching seem to overlap considerably with the 'community of inquiry' characteristics identified by Matthew Lipman as part of P4C approaches. To what extent do you agree that deep thinking requires collaborative learning? The EEF Toolkit provides some evidence of an association between collaborative learning approaches and attainment with a measure of five months' progress. The EEF did complete a relatively short-term study on dialogic teaching interventions and identified an impact of two months' progress. Teachers involved were positive and felt they needed more time to see the benefits of the intervention.

Dialogic teaching, 'learning through oracy', is identified as one dimension of oracy by the recent Oracy Education Commission in their final report (2024). They also focus on 'learning to talk' and 'learning about talk' (2024: pp15-19). The Commission define oracy as: 'Articulating ideas, developing understanding and engaging with others through speaking, listening and communication' (2024: p14). They hope to influence the government's curriculum and assessment review planned for 2025. The report proposes integrating oracy across the curriculum to build pupils' confidence, self-efficacy and sense of belonging, as well as promoting learning, citizenship, and employability. The Commission argues that oracy is particularly significant in an age of technology and social media. A useful paper as part of the

Commission's work focuses on 'disciplinary oracy' and the ambition for pupils to be able to 'speak like a specialist' (Moorghen, 2024). Being able to 'disagree agreeably' is seen as useful for learning across a broad curriculum (Oracy Education Commission, 2024).

Inquiry-Based Teaching and 'Neriage'

Perhaps using inquiry-based teaching to engage with big ideas (key concepts) is risky? Pupils engaged in collaborative problem-solving might apply and retain misconceptions. Inquiry-based teaching of maths in Japan offers some insight into this issue (Inouke, 2011; 2019). 'Neriage' is the lesson phase within Japanese inquiry-based lessons where, using whole class discussion, the teacher draws out the solutions identified by pupils in their buddy pair work and helps the whole class to evaluate and work towards consensus. The final stage of an inquiry lesson is 'Matome' where the teacher summarizes the key idea developed through Neriage. Typically, the teacher writes the summary on the board then asks the whole class to recite it and then to write it in their notes. The teacher will often present a few slightly more advanced problems and ask the pupils how they would approach the new problems using what they have learned. The value of the concept of Neriage as well as Matome across all curriculum subjects is that it offers a possible way to avoid leaving children with misconceptions, to lead the whole class towards a consensus understanding of the key concept. Within the UK projects that focus on deep thinking have used alternative terms for what is perhaps a similar process to Neriage and Matome, for example the Thinking Through Geography project uses the term 'debriefing'. There is no direct study by the EEF on inquiry-based teaching approaches but the studies on collaborative learning and dialogic teaching could be considered relevant.

The Semantic Dimension of Legitimation Code Theory

The Semantic Dimension of Legitimation Code Theory (LCT) is most widely known as considering the 'semantic wave' of a lesson. Put simply, this is a consideration of how the knowledge introduced by a teacher is either abstract or concrete, and is either simple or complex. The semantic dimension seems relevant to our professional inquiry because it helps to analyse the dilemma faced by teachers as they balance introduction of abstract 'big ideas' using subject specialist terminology with the use of concrete examples explained in everyday language to support pupils' engagement and understanding (Boyd, Hymer and Lockney, 2015). Teaching can often be characterized by a 'repeated pattern of unpacking abstract concepts and complex academic language into context-dependent and simpler meanings' (Maton, 2020: 60).

The Semantic Dimension can be expressed as a Cartesian plane with two dimensions as shown in the diagram below.

LCT uses a concept of 'semantic gravity' which is about the context dependence of an element of the content knowledge of a lesson. If the teacher, or a learner, introduces a concrete example with simple language, then that has considerable positive semantic gravity (SG+). The

idea is context dependent. If a teacher or learner introduces an abstract idea, then that has less semantic gravity and is negative semantic gravity (SG-). It is less context dependent.

LCT uses a concept of 'semantic density' which is about the complexity of language used within a lesson. If the teacher, or a learner, uses simple language and meanings then that has negative semantic density (SD-). If the teacher, or a learner, uses complex language and explanations then that has positive semantic density (SD+).

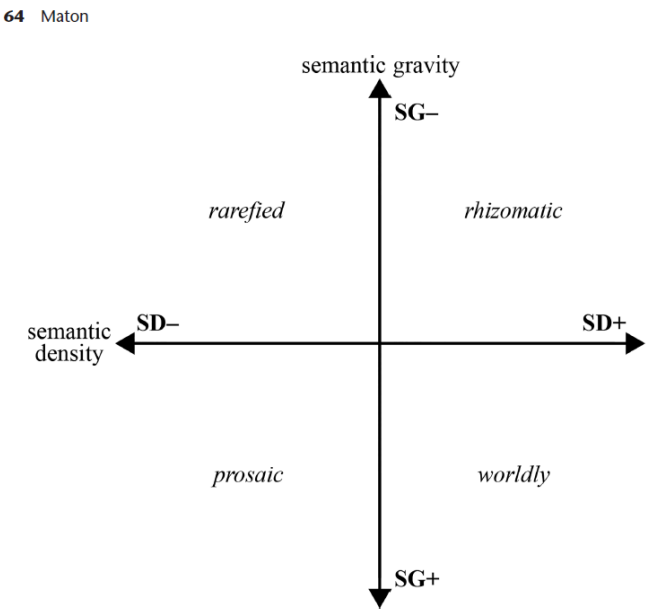

FIGURE 3.1 The semantic plane (Maton 2016: 16)

By considering these semantic concepts across a plane it is possible to generate semantic codes, organising principles that underpin classroom practice, see figure 3.1 above (Maton, 2020: 64). These four 'semantic codes' – prosaic, worldly, rarefied and rhizomatic - capture the position of a coded segment of the lesson transcript or teacher analysis data that has been placed on the semantic gravity and semantic density axes. Depending on the knowledge content of the lesson, the analyst develops a translation device to match the semantic codes to the content knowledge within the lesson. The 'description' column in the simplified example of a translation device below is generic, but in practice it would refer to the content knowledge of the lesson being analysed.

Semantic dimensions	**Semantic Code**	**Description depending on the knowledge content of the lesson (this below is generic)**
SG+ SD-	Prosaic	Simple concrete practical example
SG+ SD+	Worldly	Complex but concrete real-world example
SG- SD-	Rarefied	Simple but abstract concept
SG+ SD+	Rhizomatic	Connected, complex, abstract concept

Translation device used in LCT Semantic Dimension coding

Coding using the Semantic Dimension of LCT enables the use of language, knowledge and especially key concepts within lessons to be compared, even when the knowledge content of the lessons is varied. The coding may enable a 'semantic wave' of the lesson to be constructed as in the diagram below.

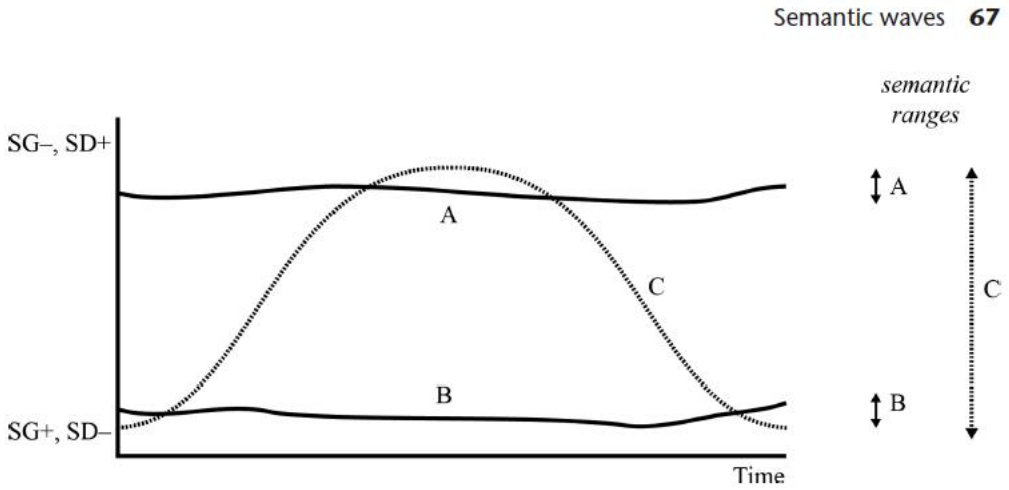

FIGURE 3.2 Three illustrative semantic profiles (Maton 2014b: 143)

In lesson A the teacher introduces and maintains an abstract level throughout which may lead to lack of engagement and understanding. In lesson B the teacher maintains a concrete and real-world language and knowledge level but this means that the students may not engage with or develop a more abstract understanding of the key concept. In lesson C the teacher begins with a real-world example or problem but builds up to introduce the more abstract key idea halfway through the lesson. They return to more real world but perhaps complex examples or meanings to conclude. It is also possible to flip lesson C by introducing an abstract key concept then moving to a learning activity involving a more concrete example or problem before ending the lesson by shifting back to a more complex and abstract view of the key concept.

Summary

It is important to reiterate that this review of relevant literature is far from comprehensive. Analysis in the first cycle of the professional inquiry raised the issue of identifying key concepts within teacher aims and lesson objectives. From the literature review the application of the semantic wave idea seemed relevant and was included within the emerging cycle two research question.

Methods

The approach to this professional inquiry used some elements of Japanese 'lesson study' (Jansen et al., 2021). For example, we focused on analysing lessons and on selected small

groups of students within them. We tried to keep to the principle that the teacher teaching the 'study lesson' being shared and considered, always has the first and last word on evaluation of their lesson.

This professional inquiry also used elements of collaborative teacher action research, with two cycles of 'action research' (Baumfield et al., 2017). In the first cycle, in relation to deep thinking, we asked the question 'what is going on?' In the second cycle, after agreeing a change in classroom practice for the next cycle of data generation, we asked the question 'what if?'. So, in the second cycle we asked - what is the impact on learning when we make this planned change to our classroom practice? In effect each teacher researcher brought detailed description and evaluation of one of their lessons for each cycle of the project. If practicable they used video to capture their lesson and used that within their school to support their reflection and evaluation. They gathered some student voice after the lesson to inform their analysis.

Teacher researchers completed a description and their own evaluation of each study lesson using a template. For the overall analysis of the total of this qualitative data we used a thematic approach which is a well-established approach to qualitative analysis of qualitative (Braun and Clarke, 2006; 2012; 2022: 2023). We used a form of 'hybrid thematic analysis' (Fereday and Cochrane, 2006) but with three phases, first open coding using inductive reasoning, then coding using themes derived from the relevant literature using deductive reasoning. Finally, we applied codes from the semantic dimension of Legitimation Code Theory (LCT) to analyse the data (Ash, 2022).

In terms of ethics, the teacher researchers all owned their study lesson data and could at any stage not submit it for collaborative analysis or withdraw it. If for any reason they were not satisfied with their first study lesson teacher researchers were free to generate data using an alternative lesson. In relation to the school, all head teachers were informed of the teacher researchers' involvement in the project and gave consent.

A more detailed outline of ten steps for professional inquiry is available in an open access chapter (Boyd & White, 2018). In this kind of project teacher workload is a challenge and it seems important to limit the workload involved in teacher researcher data generation and analysis. Participation in a professional inquiry project needs to be recognised, valued, and supported, as professional development activity by school managers and within the workplace learning culture of the school. As part of evaluation of the project, in addition to the teacher researchers' study lesson evaluation, we used an online evaluation survey and connections mapping activity at the start and end of the project.

Findings

The main focus of this report is on the second cycle of data analysis.

Brief Summary of First Cycle Data Analysis

Through the initial 'stone in your shoe' activity the teacher researchers identified two broad areas of interest for professional inquiry. One issue was student engagement, specifically the lack of engagement by some students. A second issue was partly around subject curriculum terminology and language but also focused on deep thinking. Through negotiation a research question emerged for the first action research cycle: 'How do I ask pupils to identify and evaluate possible solutions to an open-ended problem within the curriculum subject and what happens when I do?'

The analysis of the first cycle data raised an issue around clearly identifying the underpinning key concept(s) within the lesson content knowledge and suggested a need to distinguish between propositional knowledge, broadly meaning facts, and procedural knowledge, broadly meaning skills. For example:

> In evaluating her art lesson, Teacher Researcher 1 was focused on engaging students in 'analysis' within art. This is a suitable ambition within procedural knowledge, for the children to analyse within the field of art, perhaps analysing like an artist. The background content knowledge, the propositional knowledge, was Brutalist art. Thinking back from this lesson idea, perhaps the big idea is that an artist analyses works of art and is able to 'classify' them within different art styles or movements. So, an underpinning big idea or key concept of the lesson is perhaps this idea in art of classification into styles, as well as being about analysis and Brutalism?
>
> Analysis of Teacher Researcher 1: Study lesson 1 Art

The analysis also identified a seemingly simple issue, that the sequence of lessons is important because the teacher might begin with a lesson in which pupils gain background knowledge before a lesson that introduces a key concept. Or a teacher might spend a lesson introducing a key concept at a simpler level before moving on to another lesson in which pupils have to apply the concept within a real-world problem-solving task and then perhaps build a more complex and connected understanding of the concept.

The focus on curriculum subject terminology and the pathways described by teachers in the cycle one study lessons, between abstract concepts and concrete examples and between simple and more complex and connected meanings, demonstrated the relevance of Legitimation Code Theory (LCT). Such pathways have been mapped across the LCT semantic plane so the teacher might be moving from Prosaic (concrete and simple) towards Rhizomatic (abstract and complex) but sometimes via Worldly (concrete but detailed) or Rarified (abstract but simple). A particular lesson or sequence might be graphed to show the semantic wave for example introducing an abstract concept in simple terms (Rarified) but then asking pupils to use it in a concrete real world problem-solving task (Prosaic or Worldly).

This analysis of the first cycle data suggested two inter-related changes in practice that might help to promote deep thinking by students within the curriculum subject:

- In lesson planning and teaching, focus in more detail on lesson objectives with particular emphasis on identifying the underpinning key concept or big idea within the content knowledge (propositional knowledge) as well as any procedural knowledge such as a developing a skill.
- In lesson planning and teaching, plan and evaluate the lesson in terms of the pathway taken to introduce abstract concepts and concrete tasks as well as moving from simpler everyday meanings to more complex and connected meanings.

These proposed changes in practice then informed the planning and data generation in action research cycle two.

Second Cycle Data Analysis

This report focuses on analysis of the second cycle of data generation. The data consists of a study lesson description and evaluation by each teacher researcher, usually involving some consideration of student voice data. In these lessons the teacher researchers introduced the agreed second cycle changes in practice but mediated these to suit their classroom context and curriculum subject. The research question developed for the second cycle to become:

> As a teacher, how do I shift, within curriculum subject lessons, between abstract concepts and concrete tasks and between simpler everyday meanings and more complex and connected meanings?

Clarifying lesson objectives is already an embedded element of teacher planning but the focus on identification of key concepts, distinguishing between propositional and procedural seemed of some value. The need to consider the prior and subsequent lessons was a useful reminder of the limitations of zooming in on a 'study lesson' without also considering its wider context within the curriculum subject and the sequence of lessons.

Theme One: Direct, Scaffolding, and Inquiry-Based Teaching Strategies

In the analysis we generated a theme of 'teaching strategies' building primarily from the lesson descriptions data and meaning the range of strategies and their sequencing within the lessons. Teacher researchers used a combination of strategies, within study lessons and across a sequence of lessons, from what might be described as 'direct instruction' through to 'inquiry-based' or 'dialogic teaching' approaches.

All the study lessons involved some elements of direct instruction, with the teacher introducing a concept by exposition and modelling or demonstration of a skill.

> *'Demo ways to turn an image into a pattern'*

Teacher Researcher 1: Study lesson 2 Art

'Models 'master paragraph' on the board'

Teacher Researcher 2: Study lesson 2 History

In another study lesson, and in the sequence of lessons around it, the teacher used a framework for writing paragraphs (point, evidence, explanation) to scaffold students' thinking and writing within the curriculum subject:

'… the students have worked on individual paragraph structure, focusing on including a clearly defined point, using evidence, and then clearly explaining their point. '

Teacher Researcher 4: Study lesson 2 Geography

Three of the lessons also involved some elements of inquiry-based teaching with dialogic teaching and collaborative learning. For example, problem-solving talk in buddy pairs or small groups leading to whole class discussion mediated by the teacher.

'My role involved providing clear instructions on task completion, eliciting ideas through targeted questioning, and facilitating the students' research into personal symbols. Ensuring that I make clear links to the learning questions and using the artistic disposition languages has provided more opportunities to challenge students' thinking.'

Teacher Researcher 1: Study lesson 2 Art

The teachers used whole class discussions as an opportunity for coaching students in learning through classroom talk. The teachers also used whole class discussion as an opportunity to address misconceptions and through 'neriage' to lead the students to a correct understanding of the key concept or skill. For example:

'In being the scribe of the discussion I placed myself both at the centre of attention – all information had to go through me to be recorded – but also at the centre of turning feedback into Worldly and Rhizomatic terms. I made sure that I coded this in two ways; by taking an unsure and unclear comment and clarifying it, and by offering extra information but asking students to word it 'like a historian would'. '

Teacher Researcher 2: Study lesson 2 History

Another approach to this kind of dialogic teaching was for students to individually use mini white boards which then helped to support whole class discussion facilitated by the teacher:

'The scaffolded discussion used open and probing questions as a starting point, and this allowed for greater depth in the discussion. The students used their mini whiteboards to record their thoughts which allowed them to practice before sharing with the class.'

Within this kind of whole-class discussion all the teachers might be working to develop a positive learning environment but for one teacher researcher in particular this was highlighted as a key issue:

> *'… I put a lot of work into building a culture of trust in the classroom… I wanted this to take the focus away from 'what have you learned' and on to 'what method of learning works for me' as well as 'what method of teaching worked this time'… In part this metacognitive approach was to address the confidence issue which is inherent in these students… By turning the focus on to judging the learning activities, students have become much more prepared to admit areas of misunderstanding or weakness.'*
>
> Teacher Researcher 2: Study lesson 2 History

Extrapolating from the small number of study lessons perhaps there might be a pattern of a teacher introducing an abstract concept using direct instruction, teacher exposition with modelling or demonstration. Perhaps the teacher then challenges the students with a problem-solving activity that requires them to apply the concept. Within the activity the students practice using the terminology and develop a more connected and complex understanding of the concept with support by the teacher listening, questioning, and coaching.

Theme Two: Complex semantic waves

In terms of teacher researchers evaluating their lessons by applying the semantic dimension of LCT the analysis generated a theme entitled 'Complex Semantic waves' meaning that that none of the lessons seemed to be a neat curve such as the curve A shown in diagram 2. Teachers found that their lessons were quite complicated in terms of shifting from abstract to concrete and from simple to more complex and connected meanings. Rather than one semantic wave they identified multiple wavelets perhaps sometimes with a rather rough sea state.

> *'The second part of the lesson took the children back down to matching and naming 3-D shapes (LCT prosaic) and counting faces, edges and vertices when all sides are drawn (LCT worldly). Then challenged them to draw 3-D shapes on isometric paper (LCT rhizomatic) before completing a short reasoning questions -naming shapes from descriptions of properties (LCT rarefied). '*
>
> Teacher researcher 3: Study lesson 2 Primary Maths

Nonetheless, the teachers did find that evaluating their lessons using the semantic dimension was of some value in terms of considering their pathways from abstract concepts to concrete examples and from simple to complex meanings.

'By starting the lesson with the essay question, and introducing it as the question they would be answering I was able to start the lesson in the rarefied semantic pathway, and using the low frequency lexis which allowed them to see and hear both the style and concepts. However, by immediately asking students to share their own ideas about icebergs [a metaphor for a style of essay question] they were able to bring some prior knowledge to the lesson and to feel some confidence in their own abilities.'

Teacher Researcher 1: Study lesson 2 Art

The teacher researchers strongly linked curriculum subject specialist terminology with the key concepts underpinning their lesson. This connection between language and conceptual thinking was a strong feature in planning, facilitation, and evaluation:

'I introduced the session, building on to the previous session with vocabulary very early on. This made it clear the vocabulary and focus for the session for all of the children. Abstract ideas were shared with examples and children used dictionaries to look up any terms which they were unsure of. They also gave examples of this vocabulary in context with relevance to them. I was trying to bring the vocabulary element into the lesson early on to ensure the pupils knew it was a science lesson and were then prepared to 'think like a scientist' for the session.'

Teacher Researcher 6: Study lesson 2 Science

Teacher Researcher 3 felt constrained because she was teaching maths using a resourced scheme and did not want to throw out the existing lesson plans but try to implement the change in practice within the prescribed lessons. In this case the main change was awareness of the teacher rather than change in strategies or activities:

'Through tracking the semantic wave through the lesson, I found out how the lesson fluctuated between concrete and abstract, allowing the children to access prior knowledge, practise new concepts and secure approaches before tackling abstract concepts… As a teacher, I am unsure if noting this changed what I did in delivering this lesson as I did nothing to change the resource, order or tasks the children were given. I feel the pathway taken was beneficial for learning and enabled successful outcomes and deep thinking to occur.'

Teacher researcher 3: study lesson 2 Primary Maths

These varied strategies to promote deep thinking are often primed by direct teaching of a key concept or specialist terminology or at least revision of a body of knowledge from prior learning. The strategies then involve some form of communication, writing or planning for writing, classroom talk in buddy pairs, small groups or whole class with teacher facilitation, and making art. In this way we might consider then that 'communicating shapes your thinking' and the teachers are designing learning activities involving communication to promote deep thinking.

Theme Three: Promoting Deep Thinking

In terms of the change in practice, teacher researchers identified some positive impact on deep thinking.

> *'A greater focus on creating semantic waves in lesson; this is something I was aware of, and as a teacher of English Language at A Level, did consider. However, I intend to be more explicit in my planning for it as I feel it is a useful way of considering the move from concrete to abstract and back which is essential for the most able students, and supports the 'weaker' within our school context.'*
>
> Teacher Researcher 2: Study lesson 2 History

> *'One child said that they had to think deeply and found it a challenge yet understood the lesson. This was a change from the previous [study] lesson as challenge was clearly linked to a lack of understanding before.'*
>
> Teacher Research 3: study lesson 2 Primary Maths

Teacher researchers generally felt their change in practice for study lesson 2 had helped to promote deep thinking:

> *'The lesson itself was successful in that all students formed an opinion about the key concept of the lesson, based on the knowledge taught to them. This success demonstrated the level of trust the students have, and they were willing to consider quite abstract concepts without pushing back that they 'didn't know'. All students were willing to have a go at the tasks and there were some thoughtful responses to the images of the murals, which shows that the links to prior knowledge were important.'*
>
> Teacher Researcher 5: Study lesson 2 Art

Teacher Researcher 4 focused particularly on thinking as it informed extended writing and saw progress from this:

> *The results table … clearly shows the level of improvement made across the focus group, most students have gained marks with many making significant improvements. The overall length of responses increased, and most students had a clearer understanding of what a balanced essay looked like and were able to implement this.*
>
> Teacher Researcher 4: Study lesson 2 Geography

Teachers also considered actions they might take to pursue this issue further:

> *'My observation that students seem more confident and require less scaffolding suggests a positive development in their learning, potentially fostered by the way I've structured the project and built understanding over time. However, the continued disconnect students have between discussion and practical work highlights a potential*

area where the value of the analytical and conceptual elements might not be fully appreciated or understood by them, this suggests that I need to do further work in bridging this gap.'

Teacher Researcher 1: Study lesson 2 Art

The emphasis on key concepts and terminology:

'I'm going to be teaching my sessions using this format regularly to observe any improvements/ outcomes. I'd like to have the vocabulary on show and ask the children to unpick which area of learning they are doing. I'd also like to build this model into RE sessions and P4C sessions somehow, through experimentation and applying some of the strategies already tried. I'd love to model this type of input with my colleagues, especially with younger classes as I feel that this model would aid learners there… and reduce opportunities for cross-curricular confusion.'

Teacher Researcher 6: Study lesson 2 Science

Analysis of the teacher study lesson data generally suggests some positive impact on student learning of the focus on key concepts and lesson planning and evaluation using the semantic dimension of LCT.

Summary

This qualitative analysis has identified three inter-connected themes: 'Varied strategies'; 'Complex semantic waves'; and 'Promoting deep thinking'. Teachers focusing on key concepts and considering the idea of a semantic wave within lessons does seem to have had some impact on promoting deep thinking by students.

Discussion

The teacher researchers appear to use a repertoire of teaching and learning strategies in their lessons, but classroom talk, best captured by the literature on 'dialogic teaching' (Alexander, 2020), seems an important element of this. During whole class discussion the teacher may use 'neriage', meaning a kneading or steering of discussion of student contributions or solutions in such a way that misconceptions are addressed and the whole class is led to correct understanding of the key concept (Inoue, 2011).

A good deal of professional learning activity in education contexts tends to feel like revision or even just remembering. The 'findings' of a professional inquiry may seem like common sense to many teachers, but much of the professional learning might be personal for the teacher researchers and involves development of tacit knowledge. However, sometimes it is possible to tease out from qualitative analysis something a little bit new: a new idea or metaphor for teaching and learning that might be more widely useful.

In higher education a widely heard maxim is that 'writing shapes your thinking'. It is probably true that in school, further and higher education we do tend to privilege 'writing' as a key activity, perhaps because it relates directly to common forms of assessment. But a theme emerging from the analysis of teacher researcher lesson 2 data is that strategies are used in different curriculum subjects and lessons to promote deep thinking through talking and making art as well as through writing, so we might say that 'communicating shapes your thinking'. This idea helps to clarify the priority given to writing and how it shapes thinking but also provides a rationale for focusing on how learning activities involving oracy, as well as other formats for communication, might be designed and facilitated by teachers to promote deep thinking by students.

Conclusions

Teacher researchers in this professional inquiry investigated how to promote deep thinking and found that they use varied strategies within lessons and from one lesson to the next as part of promoting deep thinking within the curriculum subject. These strategies including direct teaching, scaffolding, for example using writing frames, and inquiry-based or dialogic teaching approaches.

Overall, teacher researchers found some evidence of positive impact on deep thinking of their students from the cycle two change in practice. In their planning and facilitation, focusing on key concepts, including distinguishing between propositional and procedural knowledge, plus consideration of the semantic pathway or wave of their lesson, did seem to promote deep thinking by students.

With some speculation based on such a small-scale professional inquiry, an idea arising from the analysis is that we might replace the well-known educational maxim 'writing shapes your thinking' with something broader such as 'communication shapes your thinking'. This idea reflects the ways that teacher researchers used talking and making art, as well as writing, to promote deep thinking by students in their classrooms and curriculum subjects.

The small size of this professional inquiry team is a limitation on the reliability of the findings, but on the other hand small size helped to quickly build engagement and trust amongst the teacher researchers. The involvement of six teacher researchers from five schools, including primary and secondary, and five curriculum subjects made the project ambitious in terms of networking and reaching across different teacher contexts. However, this may have made it less effective in developing change in practice within each of those participating schools.

Making tidy maps of the professional learning of expert teachers is perhaps not feasible or useful. This project has brought together teacher researchers from five schools as well as the

research mentor from a local university and the project lead from One Cumbria Teaching School Hub. Through collaboration and sharing practice they have built a level of trust and begun the development of a professional learning network. They have strengthened their epistemic insight, research literacy, and agency in developing research-informed classroom practice. In addition to this report, the teacher researchers have presented the project at a professional development conference and at an event for pre-service teachers. By sharing their findings, they have contributed to professional development more widely across the Hub and helped to promote a culture of distributed leadership and teacher agency through collaborative professional inquiry.

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