A trajectory for the development of teacher leadership in science education

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Abstract

This theoretical paper presents the Trajectory of Professional Development (TOPD) as a conceptual model for teacher continuous professional development (CPD). The model's five stages are described and justified using rich descriptive statements from teachers and teacher educators working with the University of Manchester's Science & Engineering Education Research and Innovation Hub (SEERIH). The paper offers insight into the nature of professional progression and contributes to the literature on teacher leadership, by focusing more on the process of professional development from the juxtaposed perspectives of participant and teacher educator, comparing the TOPD model to that of Fairman and MacKenzie's 'Nine Spheres' (2012).

Keywords: teacher leadership; professional learning; continued professional development; science education; teacher identity

Introduction

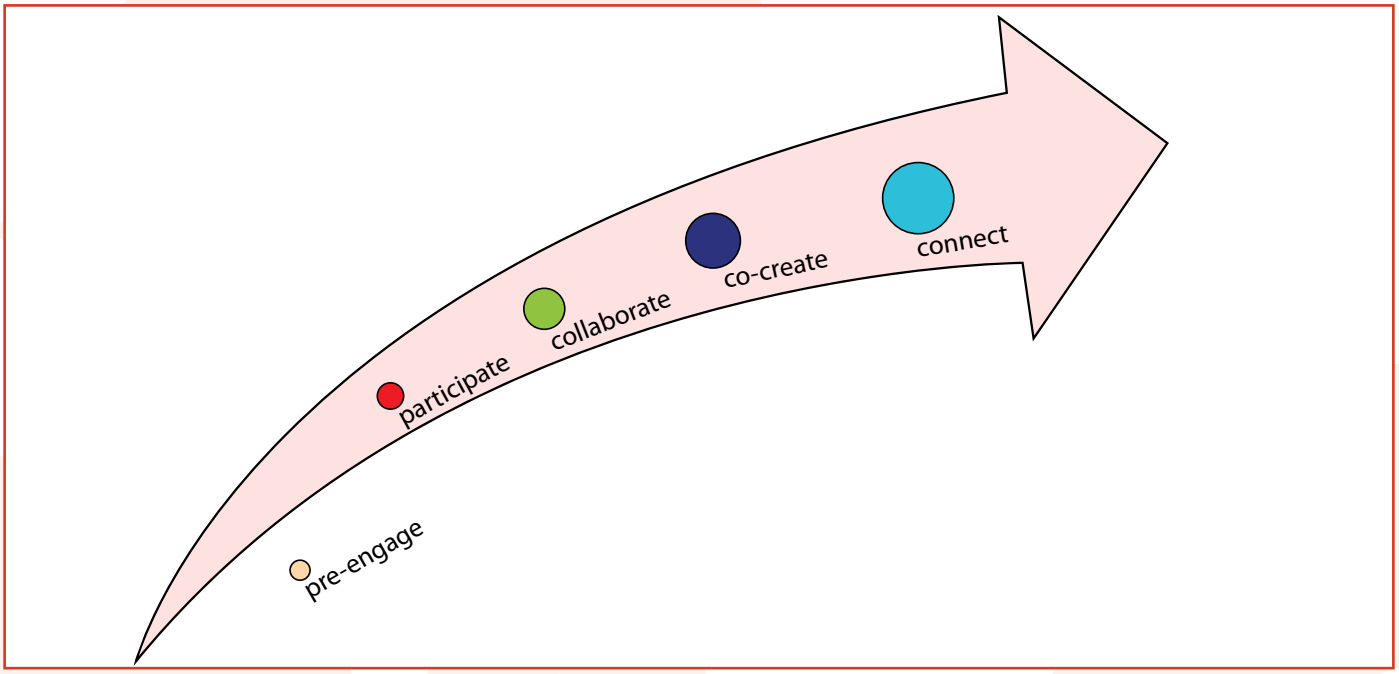
The University of Manchester's Science & Engineering Education Research and Innovation Hub (SEERIH) offers in-service teachers a programme of continuous professional development (CPD) focused on the improvement of teaching and learning of primary school science and engineering education. Through a variety of CPD opportunities, SEERIH offers one-off showcase events, sequential courses, networking meetings, thematic or regionally-focused clusters and curriculum and research projects. The SEERIH programme acknowledges the need to recognise, appreciate, understand and respond to a learner's personal needs, which can be closely aligned with their self-efficacy, confidence and identity with science. Building on the work of Fairman and Mackenzie's nine spheres of teacher leadership (2012), and reflecting on the range of CPD experiences offered by the Hub, it has become apparent that successful development of science teacher leaders progresses through a series of linked stages. These stages (informed by the CPD evaluative processes) are synthesised in the 'Trajectory of Professional Development' (TOPD) suggested below. The model aims to broaden and deepen understanding of the mechanisms that enable teachers to be supported in developing a professional identity as leaders in science education.

This paper therefore presents a conceptual model for teacher CPD that has been developed based on the author's professional experience over the past ten years. Reflecting on the processes in which teachers engage to become effective science leaders, there are 'key' or 'essential' stages within their CPD through which all the participants on our programmes are encouraged to progress. This theoretical paper therefore provides readers with a description, justification and exemplification of five stages of development of the conceptual framework, which other educators involved in professional development can use in their own practice.

The value of the framework is that it makes explicit many developmental processes that are implicit or almost taken for granted in one's personal and professional life. As Schon (1983) indicates, reflection is key to re-evaluating the tacit knowledge of developing practice, which can quickly become unthinking and routine. The framework offers an explicit and shared language for teachers and teacher educators to review and describe professional development, in which the five stages clarify progress during one's CPD journey.

Such reflection is in keeping with what Schon (1983: 61) refers to as 'reflection-on-action', where practitioners reflect *on* their knowing-in-practice (i.e. you as a professional developer). Griggs and McGregor (2011) suggest that *'sometimes, in the relative tranquility of the post-mortem, [teachers]*

Figure 1: The Trajectory of Professional Development (TOPD): A model for teacher leadership



think back on a project they have undertaken, a situation they have lived through, and they explore the understandings they have brought to their handling of the case.' It is this reflective activity, stimulated by the CPD framework, which has been shown to be of interest and benefit to teachers and their CPD teacher educators. It has enabled teacher educators to reflect on how the CPD experiences they develop are addressing the needs of the right teacher at the right time on the right issue: *'As an experienced provider of CPD in science education and an active member of the primary science community, the TOPD model provided a real focus on learning and the awareness that depth of learning is more meaningful than simply more and more knowledge. In the first instance, I was able to reflect in a more meaningful way when an event had not been as successful as usual. I no longer blamed the difficult audience, but recognised that there was a mismatch between where the participants sat on the arrow and the approach taken. This reflective insight then linked to the informative opportunity of the arrow to better identify the rationale, and therefore audience, of the CPD event and plan more effectively to meet a targeted need'* (Teacher educator, 20 years' experience).

Background and literature

The framework ultimately supports the development of teacher leaders in educational settings and builds on literature from Frost (2003), York-Barr and Duke (2004) and Leithwood *et al* (2004). The framework extends Fairman and Mackenzie's (2012) findings that teachers are internally driven to expand their professional knowledge and skills, experiment, take risks, collaborate, seek feedback from colleagues and question their own or others' practices. How teachers are supported to harness these motivations relates to the question of 'How are teachers prepared to lead?'. York-Barr and Duke (2004) noted that, throughout the literature, there was a call for more formal preparation and support of teacher leaders (e.g. Griffin, 1995; Ovando, 1996), and that teachers are often unsupported in their development on entry to leadership roles: *'We ask teachers to assume leadership roles without any preparation or coaching, because [we assume] they appear to intuitively know how to work with their colleagues'* (Katzenmeyer & Moller, 2001, p.47).

Where such support is not provided, Katzenmeyer and Moller report a hasty retraction of teachers from leadership roles. This paper provides school leaders, educational instructors/consultants and teachers with an opportunity to categorise forms of teacher professional development that are best suited for purpose, and as such provide targeted and meaningful enrichment opportunities for staff. The current educational landscape in England places high stakes accountability measures on schools, senior leaders and teachers. Educational

reform has been strongly influenced through policy changes and related government inspection regimes. In Frost's (2003) paper on scaffolding teacher leadership, he refers to the 'command and control' approach to reform, which he suggests has taken us just about as far as it can.

He cites Horne (2001) in saying:
'Excessive centralised intervention has diminished the system's capacity to change itself and respond to wider changes that are beyond the comprehension or control of central government. The current school system is Britain is not enabling enough students or teachers to initiate change for themselves' (p.89).

As a result, the education sector has reacted by placing increased emphasis on distributed and shared leadership approaches within school. Teachers have been encouraged and promoted to guide their colleagues in professional development and curriculum reform, through the introduction of a range of leadership roles in school, such as Subject Co-ordinators, Lead Teachers, Advanced Skills Teachers, Master Teachers, Subject Leaders and, most recently, Senior Leaders in Education. By shaping teacher leadership through such appointments, the intended outcomes have augmented the profile and influence of those in middle leadership to take on responsibility for the development and outcomes within a particular subject or area of learning.

Creaby (2013) addresses how teachers' professional identity plays a role in education reform and school improvement, whereas the development and support offered for potential candidates with aspiration for leadership often focuses on improvement of classroom practice and curricular

Figure 2: Fairman & MacKenzie's Nine Spheres model

reforms. Few recognise how a would-be leader may need to reform or redevelop their identity from that of an educational practitioner into one of a leader of others. Headteachers and senior leaders have limited opportunities for this through the National College of School Leadership schemes, where teacher development focuses on enhancing teachers' knowledge and proficiency in the dissemination of best practice and supporting other colleagues. To this end, Fairman and Mackenzie's (2012) Nine Spheres of Teacher Leadership are useful to categorise what is relevant for teachers in acting out leadership roles to advance their vision of school improvement. Their analysis provides a deeper understanding of the ways in which teachers demonstrate leadership, and the types of behaviours and interactions in which they engage to create and lead professional learning opportunities with others. Their spheres of teacher leadership for action learning include: when individual teachers engage in learning about their practice, experiment and reflect, share ideas and learn, collaborate and reflect on collective work, question, advocate and build support and organisational capacity.

Fairman and MacKenzie's spheres focus on the prime goal of improving student learning (see Figure 2) that relate to the TOPD model (see Figure 1). Common themes relating these two frameworks are the manner in which teacher leaders can be seen to participate in learning about practice; collaborate with each other; and share work outside the school (connect).
The TOPD model extends that of Fairman and MacKenzie by contributing to the debate on the temporal (or longitudinal) dimension of teacher development that can occur throughout one's career, and how, over that period, the 'would-be-teacher-leaders' move across the trajectory from pre-engagement to participation, collaboration, co-creation and connection.

This paper contributes to this area of research into teacher leadership, and further develops it by bridging the gap between aspirational motives towards being a leader and the actual performing of the role. The paper promotes the TOPD model in order to explain 'how' teachers can be supported in their development – how teacher educators can facilitate the progression and development for a teacher leader. It acknowledges that, despite being placed in a leadership position or role, a teacher needs support and opportunity to grow and develop into that role. The mere act of being awarded a new role title does not result in 'ready-made' leaders, and mentoring, coaching and support are required to bridge the transition into the leadership position in order to demonstrate and enact the role with confidence.

The 'arrow' frames the development across five stages of professional growth and the context in which it happens. The trajectory of the TOPD denotes an increasing level of ownership and autonomy that a teacher can adopt regarding his/her personal development and, in doing so, relates to the development of his/her identity as a leader. The TOPD model recognises that leadership development is defined and perhaps tightly related to a context, setting or place that has impact and influence on the teacher's position at one time.

Alongside making the progressive nature of PD more explicit, the TOPD model emphasises the importance of 'co-creation', an interactional process essential for teacher development. This is a stage of development when teachers go beyond collaborating with others to share information, explore ideas, etc. that they have received from another person, into a role where they focus on improving teaching and learning for students through the creation of their own new ideas or approaches. At this stage, they are taking what they know and have learnt to creatively explore new options, possibilities or designs for learning, whether that is an approach, a resource or behaviour.

Co-creation is a process that enables teachers to be autonomous in using their pedagogical curiosity to redefine and refine their approaches to teaching and learning, or to respond to their own educational values and philosophy in order to create new methods or processes to influence success in school. Engaging in this with others requires them to describe and justify their suggestions, build value in their suggestions with others and respond to critical feedback. By including co-creation in this framework, teachers are offered opportunities not only to respond to the reforms of others, but also to define them through their own professional voice before disseminating to others.

The TOPD model therefore provides a framework that can scaffold the development of teachers' self-awareness and agency, as they develop their identities as leaders. It highlights awareness of the different processes that come into play as the teachers progress towards becoming a leader, and of the movement between the stages of the development on the trajectory. Teachers do not have to move seamlessly between one sphere and the progressive stages of leadership, but may work their way through the different elements in a bespoke manner.

The TOPD Model: Five stages of Continued Professional Development

The Trajectory of Professional Development (TOPD) model involves five stages of development set within an upward directional arrow, which represents progress within a particular context. The stages should be viewed as essential steps or phases on the way to 'becoming' a leader (Holland *et al*, 1998), as discussed in this article, of science in a primary school. They relate to periods in a teacher's professional development career, through which s/he can progress from pre-engagement to participation to collaboration, co-creation and connection. Each stage is developmental from the last; however, teachers are not restricted in their movement between the stages. Their journey is what builds their personal profile of professional engagement.

As a teacher educator, the application of this framework is in the way that the nature of teachers' engagement in CPD is rendered more transparent, and in the tacit phases of development that aspiring teacher-leaders progress through, defined and described in ways that offer clarity and consistency of terminology and definition. The framework is rooted in the expectation that, by being more aware of, and responsive to, how teachers engage with CPD, and their motivation to change or to stay as they are, the better and more systematic our CPD offer can be. Where we work to design CPD to influence teachers' professional knowledge, skills and identity with science, we increasingly appreciate the need to differentiate the approaches that we use to maximise the impact of our efforts. We also acknowledge that, due to the increased use of social media (Twitter, Instagram, Facebook) and the access to information on the Internet, coupled with advances in digital devices, we must revisit the range and forms of CPD that can support teachers in their professional development journey towards science subject leadership in schools.

The TOPD model offered in 2D diagrammatic form illustrates a linear and upward-orientated trajectory with clear milestones at each stage. More ideally, this should be thought of as a dynamic model, where the space between the stages affords the most learning gain, as it is here where behaviour change takes place and facilitation or support may be needed. The setting of the five stages on an arrow acknowledges how the teachers' situational contexts impact on their learning. It offers opportunity to explore how the working environment, school context and formal or informal 'spaces' for learning impact on progress and a teacher's ability to develop identity as a science educator/professional learner.

The model offers a course of trajectory from pre-engage to participate, to collaborate, co-create and connect. There is no intended judgement that one stage is 'better' than another for an individual – as the 'best' place for a teacher to be might differ due to timing, circumstance, experience and opportunity. The important thing for the individual is that his/her assessment of his/her place is accurate for that individual at that time, and responsive to the context and content of the area of development. One might place him/herself at a different stage for different areas of learning at the same time, e.g. one could identify him/herself with being a collaborator when working on biology (that individual's area of development), at the same time as being able to demonstrate the skills of a connector in an area of his/her personal specialist subject, e.g. teaching and learning.

The TOPD stages in detail

The five stages within the model that signify key moments in a teacher's professional development journey are described and considered further below.

1. Pre-engage

At this stage, the model recognises teachers who have limited access or motivation to engage with formal CPD opportunities. They could be said to be

not yet consciously active in identifying their own development needs and hence are not yet in control of enhancing their professional practice, other than in an *ad hoc,* informal way. As such they are represented in the framework as sitting outside the arrow, to illustrate that the teacher is not yet consciously aware of or responsive to potential improvement of their professional practice.

The use of an analogy can support explanation of this stage. Using the context of swimming, an individual who is at the 'pre-engage' stage will be a non-swimmer. S/he feels comfortable with this state and does not have the interest or motivation to develop swimming skills. S/he can be observed to be content with watching other people learn how to swim and enjoy swimming. S/he does not feel threatened by others in this role or by the possibility of drowning if near water.

Extensive experience has shown that, where science CPD is concerned, in-service teachers and those new to science subject leadership may have had their last formal training during pre-service or undergraduate courses. School accountability and recent austerity measures in England have found that far fewer teachers are afforded the time to develop this area of practice, with little or no support provided by Local Authority school improvement teams.

As such, within this framework these teachers are found to be 'pre-engagers', as they have not had the opportunity, motivation or support to become involved in formal CPD to develop their science subject leadership abilities. This is not to say that these teachers have no interaction with learning opportunities; for instance, they may hear about a development in a staff meeting, on social media or in the newspaper, but their engagement with it is more passive than at any other stage in the framework. To use the analogy again, they are content to hear the sound of the swimming instructor whilst watching people learn to swim.

'Before I became a science subject leader, I had received very little support in the teaching of the subject. My specialism is in music and my knowledge of how to teach science in a creative, challenging and thought-provoking way was limited. I taught science on a regular basis, but I hadn't had any opportunities to attend any science courses, so I just followed the school science scheme on a weekly basis. When I was given science as my area of responsibility to lead, it was a fast learning curve and a huge challenge. I have accessed many things now that the University has offered, including various courses that have been so valuable. Having some one-to-one support has also had a very positive affect on my knowledge and confidence with the subject' (Teacher, 18 months into science subject leadership).

2. Participate

Active participation in CPD requires a teacher to have had an intrinsic or extrinsic motivation to engage. This may come from the Headteacher or senior leader in response to a school need, or the identification of a professional interest to self-develop. Often this occurs when a teacher adopts a position of responsibility and leadership within the school, in many cases a Key Stage or subject-related specialism. At this stage, teachers are found to be seeking out the opportunity to take part in CPD focused on a topic of interest or identified area of need. They are willing to engage in new learning, showing interest in the opinions of others. At this stage in their trajectory of development, they can be found to be scanning the landscape of opportunities in their areas of interest and looking for relatively immediate solutions to their needs.

Examples of CPD that may relate to the 'participate' stage might be attending a science public engagement event, course, network meeting or conference. Teachers may actively explore the Internet and social media for information and ideas, read a journal or go to a TeachMeet (an organised but informal meeting for teachers to share good practice, practical innovations and personal insights in teaching).

To have moved from 'pre-engage' to 'participate', the individual has begun to make the conscious decision to change. To use the swimming analogy, the individual has begun to realise a sense of need or interest, or has been required to become involved. S/he has developed a motivation to change, perhaps as a result of being told that s/he has to attend a swimming lesson (e.g. a lesson at school), or when reflecting on seeing other people having more fun than s/he is when swimming. These teachers have become interested in dipping their toes in the water and paddling in safe, shallow waters.

As a participator in CPD, the teacher is introduced to new ideas, approaches and ways of 'being' a leader and is willing to engage with it. Opportunities are usually relatively time-efficient in that the information offered is provided at an accessible and a relatively non-challenging level. What is presented can be readily adopted into classroom or school settings. The swimmer is given the building blocks, the core strokes or enhancements of current strokes that don't necessarily require greater dexterity or confidence, yet allow the swimmer to progress and increase his/her distance or speed in the water.

This extract is indicative of the change in motivation taking place as a teacher moves from 'pre-engage' to 'participate', and is illustrative of the quick-fix nature of the request for development. The teacher identifies the reasons for his interest and the motivation to engage, yet limits the engagement initially to copying or mimicking the practice of others, as opposed to the reframing and reflection on his own:
'I teach Year 5 and am Key Stage 2 Leader. I started there this year, and after a busy bedding-in year, as science leader I'd really like to kick things off next year. I thought today's meeting was great. It was great to hear of the good science going on in [my region]. It's the first time I've led science and my mantra has always been that if I'm "in charge" of something and responsible, I want to do a good job. I'd love [my school] to be involved in some projects next year and would love to work with you in really getting to grips with science, and particularly subject leadership.

'In the meantime, my class is in the middle of a busy production and I'd like to do a great "one off" session of science inquiry. I was thinking of doing the fruit floating one that you gave us in the Spring meeting, but would like your planning or 'notes' for that lesson so I could do it well. Do you have anything you could send me? I plan to do it on Thursday of next week.

'I'm looking forward to next year and working with you. Seeing people present today made me jealous of science in other schools and I'll do my best to get that impact in my school too' (Teacher, one year into science subject leadership, e-mail correspondence).

Teachers explained that, when engaged in this type of participation, it provided the opportunity for *'discovering new and effective ways of assessing'* (Teacher, event evaluation); and *'doing "practical activities" and having discussion over different types of inquiry'* (Deputy Headteacher, event evaluation). '[By participating with other science subject leaders I have gained] *deeper understanding of the five types of working scientifically to underpin my helping other colleagues.* [It has allowed me] *to gain confidence and understanding of science to build science teaching in school'* (Science Subject Lead teacher, written cluster reflection).

'[By participating with other science subject leaders I have] *found it most useful to have professional dialogue with other teachers and specialists. Lots of advice and information about working scientifically and how to lead this back at school.* [The cluster has given me] *lots of great ideas for science in school'* (Science Subject Lead Teacher, written cluster reflection).

Although these CPD opportunities require participants to be actively engaged, the teacher participates mainly as a receiver and interpreter of information, with active discussion and debate to align newly developed understandings with his/her own contexts and need. Teachers gain practical solutions to issues they face and enhanced awareness of good practice in their specialist areas. Professional collaboration is limited at this stage, as the individual builds confidence, skills and understanding in their own practice. CPD experiences at this stage would rarely be designed to expose, challenge or shift a teacher's philosophy for learning in the classroom. This is not about the swimmers sharing the reasons or experiences that justify why they have not felt the need to swim before, but capitalises on the enthusiasm they have to dip their toes further in the water.

3. Collaborate

The framework illustrates how teachers progress on their journey to become leaders along a trajectory of professional learning, from acquiring knowledge at the 'participate' stage to learning alongside colleagues at the 'collaborate' stage. Collaborative learning with colleagues within and beyond the school enables teachers to interpret and make sense of ideas being presented to them, and to explore with others how these can inform and/or become embedded practices in different settings. Collaboration is the process of two or

more teachers coming together to reflect, discuss and learn through practically engaging in a task or area of development.

The 'collaborate' stage requires a level of empowerment of those taking part. This may have come as a result of increased confidence and enthusiasm developed at the 'participate' stage, or as a result of the support they feel within their school or from external sources. The 'collaborate' stage would be exemplified by the swimmers now having booked onto a course of swimming lessons, where they learn with an instructor or within a group. They have identified the need, understand the advantages of being a good swimmer and the benefits this will have on their lifestyle in the future.

At this stage in the framework, science teachers are engaged more concertedly with discussion about their own practice, the approaches to teaching, learning and assessment that they use and the reasons for their choices. It aims to engage them in identification, clarification and deeper understanding of the pedagogical approaches with which they work, as opposed to 'just good ideas'. It encourages them to get behind what's happening at surface level and to explore with others issues/needs that they face and potentially share in common. It aims to begin to actively engender a sense of partnership or community, and a responsibility as members of that community to learn with and from each other. They are required to regularly attend meetings or engage in development. The onus is on them to be willing to co-operate and contribute to enhancing a professional culture with others, by taking an active role in the group:
'This week Sam went on the science course on creative science and told me about the website of bright ideas with questions, odd one out, etc. to start lessons, etc. So I had a look on the website, I was really impressed with it. Then the Year 6 teacher told me she was struggling with planning the light and shadows unit of work, she had been on Twitter asking about it (I was quite impressed with that!). So I shared my planning with her that I did in Year 3 so she could use ideas and develop it for Year 6. I showed her the website and questions that she could use for her unit of work.

'She just told me now that she went on the website, thought it was brill, planned the start of her unit last night and has used the questions from the website. How good is it that she's used Sam's course to do her planning?! (and has been in touch with [other teachers on Twitter]*) Should I be this excited? What is happening to me?!'* (Science Subject Leader, 7 months, e-mail correspondence).

Examples of collaborative CPD opportunities might include designing and delivering a staff meeting or training event, with a colleague, to peers, regular attendance at a network meeting with teachers from the same or different schools, or being an active member of a virtual forum where teachers contribute resources and critique, e.g. Twitter, *TES Connect*, #ASEchat, Facebook groups or STEM forums. The involvement is low-risk, in that there is often another person guiding or running the meeting, the teacher's involvement is managed and the topic of focus familiar yet also developmental.

To return to the swimmer analogy, as the individual becomes more confident to try things out, there is access to buoyancy aids if required and s/he can be advised not to stray too far out of his/her depth or away from the poolside.

4. Co-create

The 'co-create' stage highlights when teachers shift from sharing learning to using and applying their new understandings in creative ways. It offers opportunity for collaborative practice, drawing individuals together who share an interest and need to create new learning around a particular theme or topic.

The creation of new ideas or experimenting with ideas in new settings and contexts can occur at this stage, when teachers and colleagues from other schools, disciplines or sectors are asked to respond to a stimulus or request, e.g. a new curriculum policy, to write a new scheme of work or to present their learning to new audiences. It is distinctive from the 'collaborate' stage, as it requests those involved to use their knowledge and experience in the development of something new or original.

It relies on the cross-fertilisation of ideas and approaches and is demonstrated best when individuals are confident and experienced in their own settings. It challenges those involved to extend and apply their knowledge to address new areas of need or interest.

The use of co-teaching acts as a 'co-create' activity, in which teachers work in twos or threes to plan, deliver and reflect on a lesson. In this practice, teachers not only collaborate and create new experiences together, but also share in their delivery, providing critical feedback to their peers (Murphy *et al,* 2013).

The motivation to move to this stage can be extrinsically triggered, e.g. the request from a senior leader, network or publisher to write a lesson plan/INSET event/scheme of work, or intrinsically triggered by the interest to explore new opportunities or contexts. To return to the swimmer analogy, those people at this 'co-create' stage are now able to swim competently, have developed basic expertise in swimming and are now able to extend what they do by developing their own adaptations. They may join forces with other swimming friends or develop family games using various swimming techniques. They develop a 'new' way of using swimming stimulated by their own creativity and ideas. Their proficiency and confidence in their technical capability is to a good standard. In moving to the 'co-create' stage, we would see the swimmer begin to explore new places and/or new people to swim with, and begin to experiment with the skills acquired to explore new situations, for example, swimming in open water rather than just the swimming pool or even learning to dive or do tumble-turns, seen by more expert swimmers as a natural progression. The adaptation of established skills into new settings is challenging and rewarding for the individual, motivating him/her to eventually want to share that experience with others.

An example of this type of engagement can be seen in this extract, from a teacher who has a passion for his area of learning. He shows in this piece how he has embraced the ideas that he developed when collaborating with peers, and extended and developed it to provide new experiences to others:
'Since I have arrived back from a wonderful visit to the Jurassic Coast, a number of things have happened. Firstly, I am a fully inspired and enthused teacher who is determined to inspire and enthuse the children as much as the trip did to me... This has already been passed onto the children in my class and we are looking at changing our summer topic to a Jurassic Coast-themed series of lessons. Secondly, I have delivered two whole school assemblies on the Jurassic Coast. I have planned two staff meetings and a team meeting to showcase my newfound enthusiasm for Earth Science and rocks and soils. I have also started setting up links with the Jurassic Coast mentor to allow my school to write and Skype with a school on the Jurassic Coast, and with a colleague who can send more fossils and rocks to the school for further learning episodes.

'Most importantly, I have planned a scheme of work for the two Year 3 classes in the school. This consists of six practical and educational lessons to cover the rocks and soils topic in science. The Headteacher has allowed me to deliver this, as I am a Year 5 teacher, with the other teachers and university students present to showcase my science teaching and enthusiasm for this area. This will be acting as a CPD event for the teachers and students to ensure the teachers "teach science to the same high level that you do" (quote from the Senior Leadership Team). I am already looking forward to this as I get to further investigate and develop my knowledge of a fantastic area. There are lots of other things that have happened, which have developed me as a person and a teacher and I am truly grateful.

'Yesterday, I taught the first of the lessons to the Year 3 classes and they loved it. It was the late night parents evening at school yesterday as well. Two parents from the Year 3 class arrived at my door to thank me for sparking their children's interest in this area. The children arrived with a fossil and shark's tooth that they had found on holiday during half term. There is a wonderful buzz around science at the minute in school. So thank you to both of you for allowing me this opportunity to develop this area of science teaching. I haven't been this motivated to ensure teaching is so adventurous and awe-inspiring for a while and this has pushed it back to the front, ensuring all the lessons we plan and teach are going to be of a higher standard. It is something I love teaching and talking about and so far the children are loving learning about. My Year 5 class have gone home and researched and studied more on this topic and I have only told them stories so far' (Science Subject Lead Teacher for 2 years, e-mail correspondence).

Within the SEERIH programme, the 'co-create' stage has also been the stage where participants from other disciplines or sectors have become

involved in the CPD activity. On these occasions, teachers have engaged with scientists, engineers, business partners and cultural organisations who have collaborated in the design of new learning. The sharing of expertise has been challenging and has benefited from a CPD coach or mentor to facilitate the dialogue and creation process between the two groups.

Indicative experience suggests that a coach/mentor acts as a bridge between individuals from two different worlds and supports the individuals in translating language, process and knowledge between the sectors. At this stage, an individual's personal philosophy for learning is often exposed and, although time-consuming, it is reliant on all individuals having a strong sense of purpose, joint vision and drive. Further exploration of the role of the mentor at this stage is required and will be reported in a separate paper.

5. Connect

The final stage in the TOPD model is where CPD opportunities that teacher educators provide, seek out or create enable the teacher to lead the learning of others by sharing knowledge, skills and understanding. The 'connect' stage encourages teachers to explore how they can strategically disseminate their learning and benefits from a firm knowledge of methods or models for engaging adult learners. For this purpose, SEERIH uses models of learner engagement to support and develop teachers in this role, for instance models such as the 5Es Learning Cycle (Bybee *et al*, 1987).

The 'connect' stage represents when teachers' learning has become well embedded and they are willing and confident to provide support and advice to others in their own CPD journey. They are advocates of an area of expertise, able to draw on a range of experiences to allow them to listen to and meet the needs of others. This requires good communication skills and creativity, to share learning in ways that have a connection with their audience's roles, expertise and experience. It is important that the individual has the versatility to recognise the needs of the audience and the skill to model good teaching pedagogy whilst leading participant learning in suitable ways.

Examples of CPD opportunities to connect could be through publication or face-to-face training events. Publication may take various forms, including an article in a professional journal, writing a book/chapter, conference poster, newspaper review/blog or a case study to contribute to findings in a research or evaluative report. Training opportunities may involve a conference workshop, TeachMeet presentation, creation of a teaching video or website, design and delivery of a staff training day or demonstration at a public engagement event.

To finalise the swimming analogy, this is the stage where the swimmer is able to support others to enter the water, give advice, guide and inspire others to put their toes in the water, paddle or even sign up to a series of lessons. The individual may take part in a sporting event in which s/he is an aspirational role model for wider audiences. S/he may develop the skills to teach others to swim, although this requires development of its own.

For CPD providers, it is important to recognise that 'connect' most often manifests itself as engaging other adults in the learning process, as opposed to working with children. Teachers, however skilled at teaching youngsters, therefore require opportunity and practice to build confidence in this undertaking. The following quote from a science subject leader describes his/her development as a connector:

'When I moved into my seconded role as CPD programme leader for SEERIH, my focus was on developing opportunities for Key Stage 1 science teachers. I felt a bit nervous at the start because my role was teaching children, not adults, although I held a position on the SLT. At the start, I needed quite a bit of support to make sure that the workshops went well. It was really helpful to be in the Hub and have people around who could talk about how they did their own CPD and they gave me ideas too, like using the 5Es model. The most challenging thing I found was to try to make sure I wasn't just telling people things all the time, but that I was doing things that helped them develop and learn in ways that were active and suited them. I know I still have to practice my skills more and when I can I respond to the feedback I get – but you build confidence every time you do it' (Science Subject Leader, e-mail correspondence).

Conclusion

This paper has presented the Trajectory of Professional Development (TOPD) as a conceptual model for teacher CPD, which offers the opportunity for educators to consider the nature of professional engagement in CPD and provides description, justification and exemplification of five stages of development. The theoretical framework offered here is an articulation of a work-in-progress. There is still more to do to scrutinise the nature of each stage of development. It has shown, however, that a framework for teacher educators is useful in encouraging discussion and reflection about the nature of planning for CPD opportunities. The key aspects of the model are reflected in the positive feedback that teachers provide at the different stages in their professional learning journey toward leadership.

Further use and evaluation of the framework will focus on key aspects of interest, e.g. whether the directional arrow depicting growth and extension of the skills required for leadership is fit for purpose and representative of teacher progression in CPD, and how the role of the teacher educator impacts on teacher engagement. Reflections from some teachers suggest that the arrow creates the impression that there is an endpoint to professional development. They preferred a cyclical framework, whereby a teacher would view CPD as ongoing and repeated over time. It is of interest to understand how the educator influences the motivation and ability of a teacher to move from one stage to another. What is clear is that positive and open relationships are significant at each transition point and further analysis of their impact on teacher development would be of interest.

The Appendix provides the reader with a summary of features at each stage in the TOPD model.

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Appendix

THE STAGES	PRE ENGAGE	PARTICIPATE	COLLABORATE	CO-CREATE	CONNECT
	THE INDIVIDUAL IS...				
General description	Not yet consciously active in identifying their own development need. They are not yet in control of enhancing their professional practice, other than in an *ad hoc*, informal way.	Seeking out the opportunity to take part in CPD focused on a topic of interest or identified area of need. They are willing to be around new learning, showing interest in the opinions of others.	Coming together with two or more people to reflect on, discuss and learn through practically engaging in a task or area of development together.	Moving from sharing learning with others to using and applying their new understandings in creative ways.	Leading the learning of others by sharing knowledge, skills and understanding.
Teacher motives to engage	No motivation to change, happy with the *status quo*.	Intrinsic or extrinsic motives to participate – e.g. being sent on a course by a senior colleague, or feeling the need or interest to self develop.	Intrinsic motives generated through interest in other people's practice. Extrinsic motives may be that senior leaders wish to be part of a group.	Intrinsic interest to showcase and share knowledge and expertise. Interest in being creative and exploring new learning opportunities.	Mainly driven by intrinsic interest to support and inspire others. Aspirations to be a role model or advocate.
Typical behaviours	Passive, information is received, e.g. during a meeting, via social media or in the newspaper.	Actively engaged – the receiver of information, showing willingness to discuss and interact with the information in order to align the new learning with their own contexts and need.	Actively engaged with others, discusses their own practice and can justify their choices. They learn with others, sharing and co-operating.	Actively engaged and creating through the cross-fertilisation of ideas and approaches in an endeavour to create new ideas, learning or opportunities.	Actively disseminating and supporting others. Requires good communication skills and creativity to share learning in ways that have a connection with their audience's roles, expertise and experience.