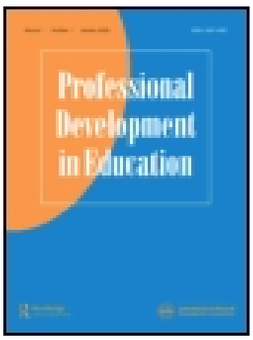

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What role can professional learning frameworks play in developing teacher agency in subject leadership in primary science?

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ABSTRACT

Frameworks for professional learning offer models of progression that analyse and describe changes in learner behaviours and practices. This paper argues that frameworks for teacher professional learning offer theoretical models that can enhance teachers' agency in their own development. Teachers' use of two primary science frameworks are considered: the Trajectory of Professional Development (TOPD) for subject leadership, and the Teacher Assessment in Primary Science (TAPS) for assessment leadership. Analysis of teacher survey data on use of the frameworks identified teacher agency and the impact of shared professional language as key themes. The paper's conclusions build on the work of Kennedy, in suggesting frameworks offer malleable tools for reflective dialogue between teachers. The authors discuss how the explicit identification of progression in behaviours and practices within the two frameworks supported teachers to develop a shared language and understanding of subject leadership, identifying next steps for their own professional learning. They make the case that the frameworks are not sufficient on their own, they can only offer non-situated explanations of development, and that for them to be of greatest benefit they need to stimulate professional dialogue and exemplification in relation to the learner's own context.

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Professional learning; primary science; teacher agency; models of professional learning

Introduction

In England, the status of primary school science relative to English and mathematics continues to be low with less financial and strategic investment (Wellcome Trust 2011, CBI 2015). There are also concerns regarding the quality of subject leadership in primary science (Wellcome Trust 2014, CFE Research 2017) and the use of assessment (Mansell and James 2009, DeLuca and Johnson 2017). It is in this context of professional learning (Swaffield *et al.* 2020) that models or frameworks have been developed to support teachers to engage in professional learning in order to develop subject leadership in primary science. Two of these frameworks, which are in use in UK schools, will be explored in this paper:

- The Trajectory of Professional Development (TOPD) (Bianchi 2017) which supports teachers to identify their level of engagement in professional learning.
- The Teacher Assessment in Primary Science (TAPS) project's pyramid-shaped school self-evaluation tool, which was developed through a Design-Based Research approach to support teachers to develop assessment practices (Davies *et al.* 2017).

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This paper will explore the way teachers have utilised these frameworks, which will be introduced fully below, and consider their role in developing teacher engagement in professional learning towards supporting their role as subject leaders. The two frameworks are used as examples, but findings will be relevant to the use of other frameworks in other contexts.

The purpose of models or frameworks for professional learning

'Professional learning' is used in its broadest sense, to include all activities of continuing professional development (CPD) and career-long professional learning (CLPL) for and by in-service teachers. 'CPD' continues to be a typical term used by teachers in England, although for some it has become synonymous with a training course that is attended, rather than the professional learning which results from such experience. In this article, 'CPD' is used to describe the 'event', whilst professional learning is considered to be the intended outcome.

A model or framework for professional learning is a theoretical description of the process. Both terms are used largely interchangeably in this article, although the term 'model' appears to place more emphasis on the theoretical description, whilst the term 'framework' implies more of a guide, perhaps meaning the latter may be more in line with the development of teacher agency. The focus for this article is not to provide an in-depth critique of models of teacher change, which has been expertly done elsewhere (e.g. Boylan *et al.* 2018), but to explore the way that teachers could use such models to lead their own professional learning. As McChesney and Aldridge (2019) argue, there is a need to move beyond the theory-practice dichotomy and it is proposed that frameworks for professional learning could bridge this divide, if they are made accessible and useful to teachers.

In their critical analysis of models for professional learning, Boylan *et al.* (2018) propose that models of professional learning should be used flexibly, using them as tools for developing better professional learning experiences. However, the focus remains on the provider, rather than using the models as tools which can be used with teachers, as proposed in this paper. Kennedy (2014) categorises professional learning models by consideration of their purpose: *'transmissive'* such as training or cascade models; *'malleable'* such as standards based, coaching or communities of practice models; or *'transformative'* such as collaborative professional inquiry models (p693). The broad category of 'malleable' is so defined because the application of such models depend on the context. For example, a model can have different purposes depending on the source of funding for the professional learning. The recognition of context, points to Kennedy's challenge to: *'the dominance of the "what works" policy-borrowing approach'* (2014: 696), reminding us that we should not assume a framework, which has been used successfully in one context, will transfer to another.

Frameworks can provide a structure for self-evaluation, a form of reflection which makes tacit knowledge explicit (Sharpe 2004), particularly if teachers are asked to discuss or share their current practices. Bolam *et al.* (2006) point out that self-evaluation can be a source of learning, although they also note that a *'solid base of expert knowledge'* (p232) is also needed. This suggests that in order for self-evaluation to be valuable, the teacher needs to have an understanding of the relevant pedagogy or criteria for the situation under examination. However, DeLuca and Johnson (2017) note that *'teachers generally maintain low levels of assessment knowledge and skills'* (p121), and Doyle *et al.* (2020) found a majority of professional development programmes did not result in an increase teacher's science knowledge, which both indicates a need for further support for professional learning.

Clarke and Hollingsworth (2002) argued that models of teacher professional development often do not recognise the complexity of the process of teacher change (p947). They identify six perspectives on teacher change: training, adaptation, personal development, local reform, systematic restructuring and change as *'growth or learning'* (p948). These perspectives can be split into those which are externally motivated (training, local reform and systematic restructuring) and those in which the teacher takes a more active lead in their own development (adaption, personal

development and 'growth or learning'). This 'active lead' has become more of a focus in recent years, with a challenge for external providers of professional learning experiences to support teacher agency. As noted by Kennedy (2019), professional learning literature also needs to critically reflect on the political and social context. Swaffield *et al.* (2020)'s conceptual framework emphasises the moderating factors of local context (e.g. school and community) and broader context (e.g. economic and political), in recognition of the situatedness of professional learning; such contextual factors will be considered further below when acknowledging the primary science context.

Clarke and Hollingsworth (2002) described a paradigm shift, from teachers as passive recipients of training, to teachers as: *'active learners shaping their professional growth through reflective participation in professional development'* (p948). But Boylan *et al.* (2018) note that agency was not an explicit feature in many models of professional learning. In Kennedy's models classification she noted that there is: *'increasing capacity for professional autonomy and teacher agency'* for those more malleable or transformative models (2014: 693), suggesting that the more transmissive model has less to offer in terms of teacher agency. Both the intended use and the actual use, by a sample of teachers, will be explored in this paper, to consider whether the use of such models by teachers themselves can enable or support teacher agency.

King (2019) describes how professional learning can empower teachers to take ownership of their own practice (p171), although also notes the conflicted position that teachers can be placed in when their values and systematic pressures are at odds. In addition, the teacher as *'change agent'* (Buchanan *et al.* 2020) also requires a range of leadership, facilitator and communication skills (p155). Such teacher agency is particularly context-dependent, and so it is necessary to understand the context of primary science subject leaders before exploring the frameworks themselves.

Subject leadership in primary science

In an English primary school, one of the class teachers is likely to have the role of science subject leader, since the responsibility for subject development is likely to be shared across the school team, with each teacher leading for one or more subjects, perhaps those in which they have a special interest or expertise. The term 'leader' is used in this study, rather than 'coordinator' since the latter implies a more managerial role, assisting with equipment for example, rather than strategic planning to move the subject forward (Bell and Ritchie 1999). The science subject leader in a primary school is different from a Head of Department in a secondary school, in that they will not line manage staff for science and so will be able to make suggestions for changes, but not necessarily be able to enforce such changes across the school. Thus the subject leader may appear to be a 'lone voice' for science, akin to the professional isolation identified by Kilpatrick and Fraser (2019) in rural schools. A key role for subject leaders is to monitor what is happening across the school, since the science teaching would normally be carried out by the class teacher. This includes mapping the science content being taught across the school to ensure coverage and progression, which is particularly important in schools where there is topic-based teaching since it may not be clear where science is taking place (Harlen 2006). The management roles support the subject to happen, whilst monitoring tasks provide the subject leader with information to facilitate decisions for strategic direction and staff needs for professional development. Thus there is the potential for professional learning of staff across the school, enabled by the professional learning of the subject leader, as they cascade training or mentor colleagues; professional learning is a 'collective enterprise' (Stoll and Seashore Louis 2007, p. 2). Such leadership development can take a critical inquiry stance, with ongoing, non-linear and iterative processes of change (Buchanan *et al.* 2020), as subject leaders trial and develop new practices in collaboration with colleagues.

Subject leadership within primary schools could be described as part of a 'self-improving' system, where teachers and schools are responsible for their own improvement (Close and Kendrick 2019), *'teachers as change agents'* (Buchanan *et al.* 2020, p. 581). But Jackson and Temperley (2007) propose that: *'the school as a unit is too small scale and isolated to provide*

scope for professional learning' (p45), arguing for the need for a network. Such a network of subject leaders would share subject specific ideas and resources, working collaboratively as a *'professional learning community'* (DuFour 2004). However, if the expertise does not exist within the school network, for areas such as science subject leadership or assessment, then an external CPD provider might be utilised to employ a transmissive model. Although Jackson and Temperley (2007) also note that a: *'centrally coordinated strategy may not be sensitive to the unique challenges of diverse contexts'* (p46). Such 'transmissive' professional learning may not be targeted enough to meet the needs of the teachers. The question for this study is whether the frameworks in question can provide a more 'malleable' model, which can provide structure and support without prescription.

Porritt (2014) describes the importance of collaboration, engagement, ownership and reflection for professional learning opportunities, which signals a wide range of skills needed by the subject leader in a primary school, whose role is to support colleagues. The subject leader will need to balance the *'multiple realities'* of the staff when implementing change, developing a clear vision which takes into account the ideas and experiences of all the people involved (Fullan 2016). Thus even if the subject leader has decided on a new course of action, they will need to consider the viewpoints of other staff to ensure that all are engaged in the development. Guskey (2002) argues that professional development first leads to changes in practice, and if these are successful, then teachers' attitudes and beliefs may change, but this process takes time and can be difficult for teachers. Porritt (2014) suggests that: *'putting knowledge to work'* is an effective way of thinking about the impact of professional learning and development. The two frameworks, which are the focus of this article, aim to support subject leaders in primary science to 'put knowledge to work' but how change is implemented in school will be dependent a wide range of contextual factors. This study does not seek to provide an in-depth study of change, although this is the focus of future work; this study provides an initial consideration of the role which frameworks could have in supporting professional learning of the primary science subject leader.

Trajectory of Professional Development (TOPD) Framework

The Trajectory of Professional Development (TOPD) framework is a conceptual model for teacher continuous professional development (CPD). The model's five stages are described and justified using rich descriptive statements (Figure 1) reflecting the processes that teachers engage in to become effective science leaders. The framework outlines the 5 'key' or 'essential' stages within

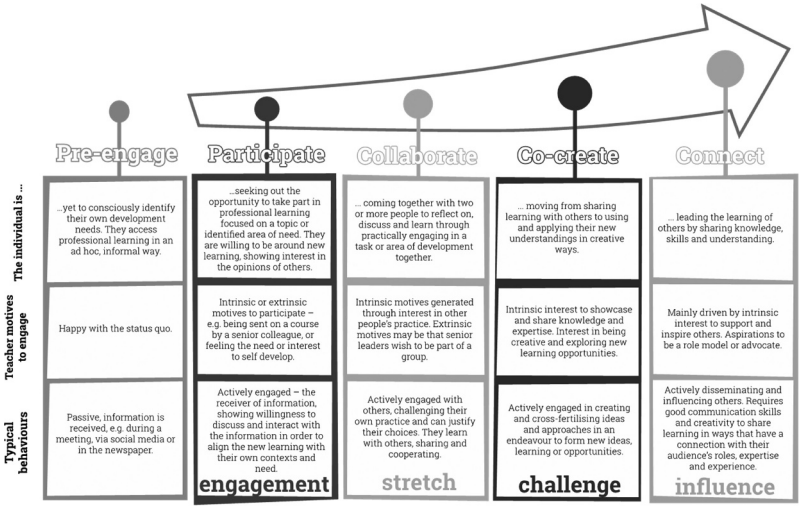

Figure 1. *The Trajectory of Professional Development (TOPD)*: a *Model for Teacher Leadership (Adapted from* Bianchi 2017).

a professional learning journey that teachers within the University of Manchester's Science and Engineering Education Research and Innovation Hub (SEERIH) membership are encouraged to progress through. The 5 stages are defined as: pre-engage, participate, collaborate, co-create and connect.

Teacher Assessment in Primary Science (TAPS) Framework

The Teacher Assessment in Primary Science (TAPS) project operationalised a model proposed by a group of experts led by Wynne Harlen (Nuffield 2012), whereby the rich formative assessment information gathered in the classroom is used to inform summative summaries of pupil attainment. The pyramid-shaped TAPS framework was developed and exemplified through sustained collaboration with schools across the UK, using a Design-Based Research approach to define principles and resources to support practice (Davies *et al.* 2017). The criteria and examples are designed to support teachers to develop active pupil participation, responsive teaching and a shared understanding of progression across the school. Figure 2 presents the key principles of the TAPS approach, with more detailed criteria and exemplification provided for teachers in the TAPS publications and website (Earle *et al.* 2015, 2017).

Both TOPD and TAPS are theoretical frameworks which are designed to be used explicitly with teachers. They could be used as models for analysing teacher change from an external viewpoint, but they are primarily models which teachers can use to develop their subject leadership and assessment practices. However, whilst the self-evaluation frameworks were designed to be used by teachers to support professional learning, exactly how they are used, if at all, cannot be assumed, thus this study seeks to explore teacher use of frameworks, in order to better understand their potential and their limitations for supporting teacher agency in professional learning.

Methods

The focus of the research was to find out about primary science teachers' use of professional learning frameworks. In order to do this, CPD events that utilised the frameworks were identified and the teachers attending the events asked about their experiences. The frameworks were used at different CPD events, since they have different purposes: TOPD focuses on science leader engagement, whilst TAPS focuses on science assessment. The purpose of the study is not to compare the two frameworks, but to explore whether such theoretical models are useful to support teacher's understanding of their own professional development.

The following research questions (RQs) are addressed:

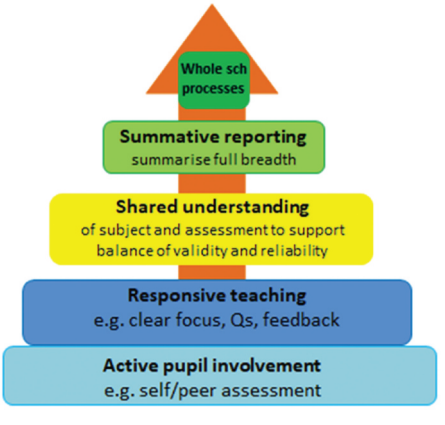

Figure 2. TAPS key principles pyramid: a model to support teacher assessment.

RQ1. Have teachers used the TOPD or TAPS frameworks?

RQ2. For those teachers who have used the TOPD or TAPS frameworks, how were they used?

The TOPD and TAPS frameworks were utilised in separate primary science subject leadership CPD programmes. The TOPD framework was employed to support reflection prior to a science subject leadership CPD event, immediately after the event and 3 months after the event. This was their first explicit exposure to the framework, which had previously been used to inform the design of the CPD. The TAPS framework was employed at 9 different CPD events which focused on methods of assessment in primary science. For some teachers, this was a first introduction to TAPS, for others, it revisited the use of the TAPS framework. The TAPS framework is also available as a web download, but analysis of download data (provided for context below) cannot reveal if and how teachers have utilised the framework. Both CPD programmes collected survey data about teacher use of the framework. The TOPD survey took place online, to facilitate teacher access and ease of completion over the 3 month period, with regular communication designed to prompt response. The TAPS survey took place at the end of each CPD session on paper, to maximise responses. All CPD events took place prior to the Covid-19 pandemic, so were held face-to-face.

In order to answer the RQs, the following survey data was gathered:

- 105 teachers completed the online survey over a 3 month period, linked to CPD events aligned with the TOPD framework. The survey included three phases of engagement: pre-event preparation, action planning and review of impact. For RQ2, the analysis focuses on 26 teachers who completed the full cycle of reflection.
- 200 feedback forms were completed at 9 TAPS events, of which 83 respondents indicated that they had seen TAPS resources before. For RQ2, the analysis focuses on these 83 since they would have had the opportunity and time to engage with the framework.

All data was ethically collected, with explicit permission given by the participants for the use of their answers for research purposes (BERA 2018). The data was anonymised and stored securely, in line with guidelines at the host institution. Qualitative thematic analysis of the survey data was carried out for each data-set, with a particular focus on teacher use of the frameworks to support coding of themes within the data. Frequencies of themes were calculated for consideration of prevalence in the data, together with identifying illustrative descriptive comments from teachers to enable discussion of findings below. Both data-sets were interrogated in their entirety, and the RQs guided the selection of data for further analysis. An example of this being where the 117 teachers who had not seen the TAPS framework before were unable to comment about their use of it in supporting school practice at that time, and so were not included in the analysis for RQ2.

A limitation of this study is that ongoing teacher use and longer term application of the frameworks was not possible to review with these teacher cohorts, however, further research into the impact of such frameworks is currently under way. In line with Design-Based Research methodology, timely feedback for usefulness of the 'product' (in this case the frameworks), is necessary for adapting and refining or 'rapid iteration' (Easterday *et al.* 2018). Thus identifying if (RQ1) and how (RQ2) the frameworks are being used by teachers, can inform further development of the theoretical models.

The use of self-report teacher data has the advantage of efficient collection, although it must be noted both that teachers may present their practice in a more favourable light and that those teachers reacting more negatively to the frameworks may have chosen not to respond to the surveys. Nevertheless, this study sought to find out about teachers' viewpoints thus it is reliant on self-reporting; such surveys also value the teacher voice. Since teacher agency was a main concern for this study, to find out whether the provision of theoretical frameworks was a supportive mechanism for professional learning, it was felt important to: *'invite them to give an account, rather than insist they be held to account'* (McChesney and Aldridge 2019, p. 318). It was felt that the RQs required the

larger sample afforded by a survey, but future work will consider individual stories in more detail through participant interviews.

Findings: use of the TOPD framework

The TOPD framework survey was used for self-evaluation before the professional learning event: a one-day teacher conference on primary science. It was used over a 3 month period: planning phase: prior to the conference (N = 105), action phase: immediately after the conference to log emerging actions (N = 43); and the impact phase: 3 months after to capture teacher's report about impact (N = 26). The survey involved a range of questions which required checkbox responses with pre-defined answer settings and short paragraph responses for qualitative descriptive information.

Initial self-ratings (see Table 1), submitted before the teachers had undertaken the CPD identifies that over half (56%) of teachers rated their engagement in the pre-engage and participate stages of the TOPD framework, with 31% identifying as collaborators and 12% creators and connectors.

Post-CPD event the teachers' responses which equate to 25% of the main cohort demonstrate changes in three particular ways as can be seen in Figure 3 and Table 2.

(1) a shift 'up' the trajectory, with a drop of 15% pre-engagers to 0%
(2) a fall in participator and collaborator numbers 81% to 46% collectively
(3) an increase of non-responses from 0% to 54%.

Extracts 1–3 below contain an example of the detail provided by teachers across the three phases of the TOPD framework survey. Descriptive information offers insight into the motives of the teacher and their senior leaders before embarking on the professional learning, where prompts enabled them to describe the importance of the event on the teacher, the school and the pupils.

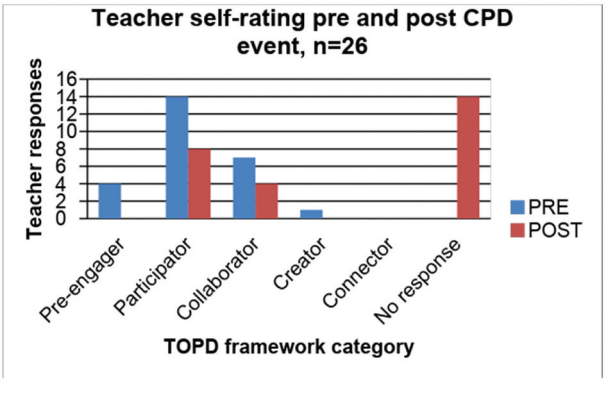

Figure 3. TOPD pre and post CPD event self-evaluation ratings.

Table 1. TOPD pre-CPD event self-ratings.

Category	Response description (n = 105)	Number	%
Pre-engager	I haven't had opportunity or motivation to engage in professional learning with SEERIH before	27	26
Participator	I have started to take part in some courses, events and activities with SEERIH	32	30
Collaborator	I am involved with other teachers, sharing existing knowledge I have and learning from theirs	33	31
Creator	I am involved with others and developing new knowledge together, e.g. creating new resources or approaches	5	5
Connector	I am involved in influencing other teachers, teachers, within and beyond my school, enhancing their professional learning in a planned and targeted way	7	7
No response		1	0

Table 2. TOPD post-CPD self-evaluation ratings.

Category	Response description	Number PRE	%	Number POST	%
Pre-engager	I haven't had opportunity or motivation to engage in professional learning with SEERIH before	4	15	0	0
Participator	I have started to take part in some courses, events and activities with SEERIH	14	54	8	31
Collaborator	I am involved with other teachers, sharing existing knowledge I have and learning from theirs	7	27	4	15
Creator	I am involved with others and developing new knowledge together, e.g. creating new resources or approaches	1	4	0	0
Connector	I am involved in influencing other teachers, teachers, within and beyond my school, enhancing their professional learning in a planned and targeted way	0	0	0	0
No response		0	0	14	54

Three extracts are offered by way of example, taken from responses of one mid-career teacher (3–10 years' experience) who had held the position of science subject leader for 0–3 years.

Extract 1: Planning Phase descriptive data

> Personal goals (teacher): *Improve my own knowledge and understanding of working scientifically and what progression looks like.*
>
> Why it's important? (teacher): *To improve teaching and learning in science. To equip children with science skills and not just knowledge.*
>
> Senior leadership interests: *To develop my teaching ability to enable me to be an expert science teacher. Develop leadership skills in order to lead and develop the subject and other members of staff.*
>
> Why senior leaders think it's important? *Developing our expertise in teaching children the skills needed to work scientifically. The impact of this will be children becoming better scientists. Share good practice and having dialogue with people currently carrying out research in similar areas. This will support us in our own action research project in the school.*

Extract 1 suggests the teacher and senior leader motives are different, with the teacher identifying short-term or immediate classroom lesson design as their key interest in engaging with the CPD. The senior leader's response focuses on how the teacher can influence the whole school and lever system change with other teachers in the school. Both identify the children as the ultimate beneficiary of the CPD experience, despite their short-medium term goals having different underlying motives.

The survey asked teachers to action plan, identifying short term and longer term goals based on the impact they would expect to see as a result of the CPD. Extract 2 shows how the teacher and school leader's needs have been brought together through the action planning process following the professional learning experience. The emphasis on cascading information and resources to other year groups and staff steer the focus of the actions. This assumes the teacher's personal interest in improving their 'own knowledge and understanding of working scientifically and what progression looks like' had been met.

Extract 2: Action Planning Phase descriptive data

> Short term Action 1: *Map out the working scientifically objectives across the year for each year group.*
>
> Expected impact from Action 1*: More opportunities for the children to work scientifically and for these opportunities to be made explicit to them.*
>
> Short term Action 2*: Introduce staff to concept cartoons and implement a plan for them to be used in each topic.*
>
> Expected impact from Action 2: *Provide more opportunities for children to talk about their ideas. Challenge their thinking and understanding. Could be used as an assessment task in order to plan for future.*
>
> Long term Action 3: *Set up a science lab in an unused classroom.*

Expected impact from Action 3: *Raise the profile of science across the school. Improve teaching and learning. Children able to make more progress.*

Teachers were prompted to report impact in line with Guskey's (2002) 5 levels supporting the teacher to consider the significance of their learning on their personal knowledge, skills and confidence, their classroom practice, organisational practices and pupil learning. Impact was ranked on a 0–3 scale, with 0 meaning no impact and 3 meaning a great deal of impact. Descriptions, as demonstrated in Extract 3, provide insight into how personal knowledge, skills and confidence, classroom practice, colleagues and pupils benefited from the teacher's CPD. Notably the impact across this extract describes whole-school influence, beyond the individual teacher themselves.

Extract 3: Impact Phase descriptive data

Expected impact: *Raise the profile of science across the school. Improve teaching and learning. Children able to make more progress.*

Impact on knowledge, skills and confidence 0-3 Rating: *3*

Impact description: *Inspired by other professionals to engage in a wide variety of projects. Provided ideas and resources to put things into place in order to improve teaching.*

Impact on practice in the classroom 0-3 Rating: *3*

Impact description: *Resources provided that can be implemented straight into the classroom. Ideas from other professional that they have tried and tested. Practical, hands on activities which can be used in school and easily adapted so they can be used again and again.*

Impact on colleagues/organisational practice 0-3 Rating: *3*

Impact description: *I have been able to go back to school and feedback ideas and activities from the course. It helped having two people from my school on the course so we could discuss what we had done. Colleagues who lack confidence in science want ideas that they can pick up and run with and we were provided with lots of those.*

Impact on pupils' knowledge, skills and confidence is 0-3 Rating: *2*

Impact description: *The concept cartoons I have used in class have helped build on the children's knowledge and extend it. As more and more things are implemented, I believe it will have a bigger impact.*

Next steps: *More expert advice to move me on further with this area of focus*

The teacher ranked their engagement in professional learning in primary science as 'participator' at the start of the experience, and as 'collaborator' following the 3 month process. Further research would be of interest to explore the impact of the senior leader interests in facilitating this shift, and whether it would have been as notable without their input in the planning phase.

Findings: use of the TAPS framework

Since 2015, the TAPS pyramid framework (Earle *et al.* 2015, 2017) has been introduced to teachers at a range of events and has been available as a free download on the Primary Science Teaching Trust website (www.pstt.org.uk). Download data can provide information regarding the 'reach' of the framework, in terms of the number of downloads which took place. Table 3 provides details of

Table 3. Downloads of TAPS pyramid framework 2015–18.

	2015	2016	2017	2018
TAPS pyramid resource downloads	2023	3475	9230	10,253

the 'unique events', i.e. those who had not accessed the resources before, rather than those who returned to the site.

Hopwood-Stephens and McMahon (2019) found that downloads were significantly higher in regions where TAPS events were held, providing evidence to support a dissemination strategy combining face-to-face events with online resources. However, whilst the download count provides information regarding the increasing teacher interest in TAPS, it not the focus for this study because it tells us little about teacher use of the framework.

For this study, 200 delegates completed surveys at 9 TAPS events (full data-set available at Earle 2018). Teachers were asked to rate the 'usefulness' of the framework on a scale of 1–5, with 5 designating the most useful. Similar ratings of usefulness were provided by delegates whether or not they had seen the framework before, with an average newcomer rating of 4.3 (N = 110 responses) and an average experienced rating of 4.5 (N = 81 responses). However, this high 'usefulness' rating did not translate to universal adoption for those who had seen the TAPS model before (and so had the opportunity to use them), as can be seen in Table 4, with nearly half of the respondents not yet using the resource ('plans to use' and 'not used').

Nevertheless, 52% of respondents were able to describe how they had used the TAPS framework. 13% of the sample had shared the framework with colleagues, for example:

Introduced to teacher

Yes- have used it to suggest to staff that lots of different ways of recording and assessing science is OK

Used it to talk about the new National Curriculum in staff meeting

A subject leader would be expected to pass on new resources to other teachers in their school, so sharing the TAPS pyramid, or information from it, like examples of 'different ways to record and assess'*, would befit the role. For the Science Lead to play this intermediary role and to lead shared development across the school, they may need an in-depth understanding of the resource or framework, for which one introductory CPD session may not be sufficient. Although, with so many resources available for teachers, if the resources cannot be explained or found to be useful within one CPD session, then it may not be appropriate for the busy teacher.*

28% of the sample used the framework to evaluate practice in school, for example:

We spent a staff meeting in year groups identifying what we do well, next steps etc

Used it to self-assess current science assessment in the school. It was good at highlighting gaps in current assessment.

I asked all teachers to complete a pyramid for their class. This has shown inconsistencies across the federation and given me areas to focus on next year.

Yes. I gave to each year group teacher to assess what they were doing and could evidence and what they weren't doing so that we could target specific needs for CPD.

Table 4. Described use of the TAPS pyramid framework (N = 83).

Use of TAPS (described by teachers who had previously seen TAPS)	Number	%
Describes changes made as a result of TAPS	9	11
Used to self-evaluate/audit, identified area/part to work on	23	28
Shown to colleagues/argue for science	11	13
Plans to use	30	36
Not used	10	12

School self-evaluation of assessment practice is a more strategic action by the subject leader, with the teachers taking their own decisions about future development. Identifying *'gaps'* or '*next steps'*, indicates a planning of future action, although it cannot be assumed that such action subsequently took place, especially without support from senior leaders in the school.

11% described changes in practice, for example:

> *Used initially to focus on in class pupil aspects to ensure lessons involved children actively engaging with assessment.*
>
> *We look at it as part of our cluster. Each school looked at one part of the pyramid and worked on it over the year.*
>
> *Yes- we discussed the pyramid during science staff meeting following up the previous best practice meeting. It helped us to identify major gaps in our approach to science. We've since started science before and after entry exit cards across the whole school, which will provide great evidence for the future moderations.*

Changes in practice take time, so it would perhaps be expected that only a small number of subject leaders would be reporting such changes. It is also not possible to know how widespread, long lasting or purposeful such changes were. For example, whether the introduction of '*exit cards'* was primarily to gather evidence, or whether this new assessment information was used formatively to adapt future teaching. The TAPS data has provided an insight into initial uses of the framework, but further research is needed to consider practice over time.

Discussion

In response to RQ1, both TOPD and TAPS frameworks were initially deemed useful by the teachers, with subject leaders using TOPD to make initial self-ratings, or rating TAPS as highly useful. However, only a quarter of the teachers involved in the TOPD study completed the full cycle of reflection and only half of those who did complete the cycle used the TOPD framework to rate their stage of professional learning. Likewise, of those who had seen the TAPS framework before, and thus had time to use it, only half had done anything with it and only 11% described changes to practice. There could a be multitude of reasons for the lack of use of the frameworks, for example, lack of time for the subject leader role, lack of supportive ethos for change within the school, lack of time to implement change before being asked to respond to questions about practice; together with elements about the frameworks themselves. Further research would be needed to find out more detail from participants, although seeking opinions from non-responders would be a difficult line of enquiry to follow. The wider context regarding the low status of science may provide powerful moderating factors (Swaffield *et al.* 2020) to subject leader engagement in professional learning and their ability to influence school-wide change.

Nevertheless, utilising Kennedy's (2014) categorisation of models of professional learning may provide some insight into the use of the frameworks. TOPD aims to be a transformative model, placing the teacher in charge of their professional learning, however, it does not prescribe changes to be made, which perhaps means that such a model would take both time and external support to be implemented. The subject leader may need support from other teachers or senior leaders in their school to implement changes if they are at the 'collaborator, co-creator or connector' level; or they may need support with pedagogical content knowledge from external providers if at the 'pre-engage or participate' stage. Whilst TAPS is designed to be more of a 'malleable' model (Kennedy 2014), being used as a source of examples for some and a self-evaluation tool for others. However, this also requires the support of others in school, for example, to be allocated staff meeting time to introduce innovations to the other teachers. In addition, such teacher-led change, requiring a 'critical inquiry stance' towards their own and others' development (Buchanan *et al.* 2020) takes more time and commitment than more linear models of transmission.

Kennedy (2014) notes the need to consider 'theory in context' (p690) and Swaffield *et al.* (2020) identify context as a key principle of professional learning. Thus it is essential to consider the

implications of the low status of primary science, which may mean that teachers need senior leadership support to implement developments. With other teachers focused on seemingly more important initiatives which directly impact on school accountability measures, the subject leader may become a 'lone voice' for science in the school, leading to professional isolation (Kilpatrick and Fraser (2019). Since both frameworks are designed to support the science subject leader in a school, then they both suffer from the same contextual factors, in that subject leader professional learning requires the involvement of others to implement changes across the school. A different framework for primary science, the Primary Science Quality Mark, ensures this whole school 'buy in' as an 'Award-bearing' malleable model (Kennedy 2014); where the school does not receive the award unless their submission of reflections and evidence meets the criteria of professional learning of the subject leader and other teachers. For freely available frameworks like TOPD and TAPS, such whole school commitment is less attainable, but future research should consider how to involve senior leaders so that subject leadership action plans can be put into action. For example, in the current Education Endowment Foundation TAPS randomised control trial (Focus4TAPS), head teachers were invited to an introductory meeting so that they would know what their subject leaders might need support with. Similarly SEERIH offer an introductory meeting at the beginning of each 2-year programme of subject leadership development, in which the TOPD framework is explained.

In answer to RQ2, for those teachers who did make use of the TOPD or TAPS frameworks, they were largely used for reflective purposes, for example, self-rating or school self-evaluation. It could be argued that this is a step to action, to identify what is happening and select what should happen next. However, it could also be argued that little action is evident in the sample, that the frameworks have provoked thinking, but little change. As Guskey (2002) noted above, change does take time and both the TOPD and TAPS frameworks are targeted at supporting complex areas of practice; with subject leadership dependent on others and assessment intertwined with teaching and learning. Black and Harrison (2010) suggest development of teacher practice requires regular and sustained opportunities for professional dialogue to promote teacher reflection and learning, with changes to practice taking in excess of 18 months in one study. Sharpe (2004) proposed that the most effective professional learning includes cycles of development, whilst Kiefer Hipp and Bumpers Huffman (2007) note the importance of *'supportive conditions'* (p121). This indicates the need for ongoing support, which could be based around frameworks, but such a model is only one part of the process. A framework could provide a stimulus for critical inquiry (Buchanan *et al.* 2020) or a focus for peer dialogue in a professional learning network (Kilpatrick and Fraser 2019), but without the opportunity for dialogue, it will be difficult for professional learning to challenge the status quo (Swaffield *et al.* 2020).

McChesney and Aldridge (2019) call for professional development evaluation to be viewed formatively, so that results can inform ongoing refinement (p312). Findings in this paper provide useful feedback to the TOPD and TAPS frameworks which suggests possible refinements and additions, for example, the development of TOPD exemplification, so that subject leaders can see examples of teachers who have developed their practice and moved up the TOPD levels. Whilst TAPS needs to consider how to better involve teachers who are not subject leaders, so that developments in assessment practice can become a shared enterprise rather than a sole crusade.

Frameworks provide a starting point for professional learning reflections and discussions, with some teachers in this study describing TOPD and TAPS as useful and using them to self-evaluate their leadership (TOPD) or school assessment practices (TAPS). However, with approximately half of the teachers in this study not making further use of the TOPD or TAPS models, it appears that a framework is not sufficient on its own, further support and scaffolds are needed for ongoing engagement in professional learning. The role of examples has become particularly important for implementation of TAPS, in order to translate theoretical principles into practice. For TOPD, the development of ongoing dialogue and partnerships plays a key role in supporting teachers to move up the trajectory of professional development. The use of face-to-face and online support to make

frameworks more accessible is a key area for further research, so that teachers can make use of these malleable tools for their own context, enhancing teacher agency in professional learning.

Conclusion

This study sought to explore the use of two professional learning frameworks with teachers in practice, to enhance development in primary science subject leadership and assessment. Rather than use conceptual models to reflect on teacher development from afar, the authors sought to find out if such theoretical models could be used by teachers themselves, potentially enhancing teacher agency in professional learning. This study was limited to survey responses as part of CPD events, thus further research is required to look more closely at the use of the frameworks as a stimulus for both ongoing critical reflection and dialogue, and to initiate change in teacher practice. Nevertheless, the implication from this study is that sharing exemplified conceptual frameworks with teachers can provide a malleable tool with which to support professional learning and critical reflection, bridging the theory-practice divide (McChesney and Aldridge (2019). It is suggested that such tools are not on their own sufficient, there is no 'magic bullet', but they may offer the potential to provide a framework in which the teacher can place themselves and their school, to be able to evaluate potential next steps for development.

With much current professional learning literature focusing on teacher agency and contextual factors, this study adds to the field by demonstrating how conceptual frameworks can support dialogue with and between teachers. The frameworks provided a shared professional language for the discussion of subject leadership and primary science assessment, which could support professional dialogue across the school. Findings suggest that teachers were interested and initially engaged with the frameworks, but further investigation of mitigating factors and context are integral to understanding the barriers and facilitators for professional learning in primary science leadership and assessment.

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