

Building capacity for professional development: the development of teachers as facilitators in Ghana

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Published version

PERRY, Emily and BEVINS, Stuart (2018). Building capacity for professional development: the development of teachers as facilitators in Ghana. *Professional development in education*, 1-15.

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Abstract

In low and middle income countries, cascade models of teacher professional development are often used as routes to educational reform. In these models, external agents deliver professional development which is then disseminated by in-country facilitators. However, little is known about how to support facilitators of professional development, particularly in low and middle income countries.

In this study, we report on a model of capacity building for professional development in Ghana. In the context of a large-scale programme of science teacher professional development, a group of Ghanaian teachers gradually assumed responsibility for professional development facilitation, working alongside experienced facilitators from the UK. Using interviews focussed on a storyline technique, we explore the experiences of the Ghanaian teachers as they reflected on their roles.

We found the teachers' epistemological beliefs about teaching were coherent with those of the programme and suggest that this may be an important factor in the success of cascade models of professional development. The teachers gained self-confidence and improved their knowledge and skills of teaching and of professional development facilitation. We propose that this is useful learning for all facilitators and that the model described here is one which is potentially useful for capacity building in other contexts.

Key words

Professional development, Capacity building, Science education, facilitation, Ghana, professional learning

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Introduction

In the push to improve education systems around the world, reform initiatives often involve programmes of teacher professional development. These programmes aim to align teachers' practice with the objectives of reform, improve fundamental teaching skills and/or embed new pedagogical approaches. In low and middle income countries (The World Bank, 2017), where teachers often lack formal qualifications and basic skills (Adedeji & Olaniyan, 2011), these types of professional development programmes are prevalent (for example Haßler, et al., 2015, Hardman, et al., 2011). Policies and pedagogies are often imported from higher income countries and facilitators drawn from the same countries, particularly those with post-colonial relationships such as within the British Commonwealth (Khalifa, et al., 2014).

This strategy of importing practice from more established education systems has been widely criticised for not paying attention to the particular contexts of lower income countries (Hardman, et al., 2011) and the use of external facilitators can exacerbate this lack of contextual understanding. Additionally, dependence on external facilitators can limit widespread impact by maintaining the need for support from overseas agents (Haßler, et al., 2015). Therefore, to extend reach at relatively low cost, large-scale initiatives sometimes involve a cascade-type model of professional development. In these models, an initial cohort of participants later disseminates their learning to colleagues in their own and other schools. This newly established team of in-country facilitators might be expected to deliver a programme with more contextual sympathy and a better understanding of how to mitigate against local barriers to change compared to facilitators from overseas. However, these cascade-type models have been widely criticised for their lack of impact (Bett, 2016, Kelani & Khourey-Bowers, 2012).

Given the prevalence of these types of models of professional development, and the widely acknowledged importance of teacher professional development more generally, relatively little research is carried out into professional development facilitators (van Driel, et al., 2012). By facilitators, we mean those practitioners who plan and deliver professional development programmes for teachers, whether they combine this role with teaching or teacher education, or operate exclusively as facilitators. In particular, only a few studies have paid attention to the learning and development needed for facilitators to carry out the role (examples include Krell & Dana, 2012, O'Dwyer & Atli, 2015, Margolis & Doring, 2013, Elliott, 2005, Lange & Meaney, 2013, Linder, et al., 2015, Stein, et al., 1999) and even fewer have considered suitable models to support these (Perry & Boylan, 2017). In particular, there is a lack of research on professional development facilitation in low and middle income countries; it might be expected that this gap in knowledge contributes to the challenges described above.

This paper contributes to addressing this research gap through a study of a group of Ghanaian teachers who participated in, and then took on the role of facilitator of, a government-funded programme of professional development for science teachers. Using a storyline technique, we investigated the teachers' experiences as they worked alongside facilitators from the UK to gradually take on responsibility for the facilitation of the professional development programme. In this paper

we set the study in the Ghanaian context and describe the model of facilitator capacity building. We analyse the learning of the teachers and categorise this as knowledge and skills for teaching and facilitation knowledge and skills. We suggest that these categories of learning are necessary for all facilitators and offer the model described here as one which can support this learning, thereby building capacity for professional development facilitation. We note the impact of being identified as a facilitator on the teachers' confidence and consider briefly whether this might provide a useful driver for teacher retention. Finally, we identify an epistemological coherence in the beliefs of the facilitators with those of the programme, which, we speculate, may be important in the success of cascade-type models of professional development. Throughout, we highlight the importance of facilitators of professional development being given opportunities and support to reflect on and improve their knowledge and skills in their roles.

The Ghanaian context

In Ghana, as in many other low and middle income countries, the education system has struggled with the persistent legacy of a postcolonial model of education characterised by the relegation of technical and vocational education in favour of the promotion of Christian values and a more classical education (Graham, 2013, Macbeath et al., 2012). Science, mathematics and technology education in Ghana has under-performed, as evidenced by the Trends in International Mathematics and Science Study (TIMSS) in 2003 and 2007: at Junior High School students (12-15 years old) were ranked 43rd from 44 participating countries and 46th from 47 countries respectively with results for Senior High School students (15-18 years old) showing similar outcomes (Agyei & Voogt, 2011). As a result, Ghana's manufacturing and technological industries have suffered through an emergent skills gap which has yet to be fully addressed (Osei & Brock, 2006). However, there has been a significant increase in student enrolments at all levels of education and especially in areas of deprivation (The World Bank, 2012), due, in part, to a policy change in 2007 by which education from the age of 4 became both compulsory and free (UNESCO, 2015). This suggests that positive change is taking place.

In Ghana the routes into teaching are comprehensive, with initial teacher education offered through 41 public and/or private colleges of education (Institute of Education, 2013). The main certification for teachers is through the Diploma in Basic Education with examinations and accreditation conducted by the Institute of Education, University of Cape Coast, which also offers bachelor's degree programs in education at Grades K-9 and high school Grades 10-12. In addition, the University of Education, Winneba, trains teachers for pre-tertiary schools Grades K-12 through. Initial teacher education in Ghana helps to prepare teachers for first cycle schools (nursery, kindergarten, primary and junior high schools) and second cycle schools (senior high, vocational and technical schools), while a number of in-service professional development programmes are offered at school, cluster and district levels by a range of colleges of education.

However, this offer does not, in itself, guarantee a pool of high quality trained teachers. Asare and Nti (2014) argue that teacher trainees in Ghana are provided with pedagogical methods which are prescriptive, rote and are not appropriate for the teaching and learning contexts of the schools where they teach or aspire to teach. These authors suggest that teacher preparation and teacher professional development programmes should be reconsidered and modified to take account of reflective practice, critical thinking and inquiry-led approaches to teaching and learning. They point

out that if Ghanaian teacher preparation and professional development programmes are not cognisant of international advances in the field, which promote reflection, critical thinking and inquiry into practice as core elements of professional learning, then school education will not move away from traditional rote methods and professional development will continue to have minimal impact.

The current Ghanaian school system largely operates through an approach which supports traditional rote methods and promotes learning of facts but limits knowledge and understanding of application (Ajayi & Osalusi, 2013) and can thereby stifle student inquiry, creativity and autonomy. This issue has not been lost on Ghanaian education policy makers who increasingly recognise, and are prepared to fund, the need for education restructure and pedagogical change.

Improving science teaching in Ghana

In many countries, including Ghana, science teaching is a particular focus for reform because positive student outcomes in science are a route to greater uptake of careers in the STEM (science, technology, engineering and mathematics) sectors. This in turn is seen as a route to economic development (Department for Education and Skills, 2006, Natarajan & Chunawala, 2009, The White House, 2009). Further there is a wide consensus that a practical, inquiry-led, active approach to learning science is a desired pedagogical route to student attainment and progression to careers in the STEM subjects (Bevins & Price, 2016). Worldwide, therefore, there has been a sustained focus on factors influencing the capacity of teachers to teach science using these approaches. For example, the European Commission-funded Framework Programme 7 invested significantly through the 'Science in Society' theme in the sharing and dissemination of Inquiry Based Science Education pedagogies amongst European and associated countries (European Commission, 2015).

With this background, one aim of reform in Ghana is to prepare young people appropriately in order to support the development of Ghana's STEM sectors. In particular, the need to prepare and develop a high quality teacher workforce, which can support young people to develop the requisite knowledge and skills for these aims, is a key area of focus. Over the last ten years, the Ghanaian Ministry of Education (MoE) has therefore aimed to improve Senior High School science teachers' pedagogical approaches by providing them with the equipment, knowledge and skills to adopt practical, inquiry-led, active approaches to teaching science. It could be argued that reform which supports science teachers to teach through a more inquiry-led style is not simply a policy-import from the developed world which does not pay attention to the Ghanaian context; rather it is an attempt to bring a widely acknowledged effective pedagogical practice into the country. However the challenges of supporting teachers to adopt new approaches to teaching are widespread and common across all new policies, and are particularly difficult to overcome in low and middle income countries.

As part of this programme of reform, from 2013 – 2016 the MoE funded a series of teacher professional development programmes to run alongside the installation of full school sets of practical laboratory equipment into Senior High Schools. These programmes were administered by ITEC Global (www.itecglobal.co.uk), a UK-based education company with a long track record of support for science teaching in Ghana. It was hoped that, as a result of this professional development, science teachers would feel confident in their use of practical work as a key

pedagogical practice for the development of students' scientific knowledge and skills and that this in turn would lead to higher attainment and greater progression to careers in the STEM sectors.

The professional development programme involved a series of residential courses each of four weeks' duration in which science teachers, working in subject-focussed (chemistry, physics, biology) groups of around thirty participants, were supported by professional development facilitators from the United Kingdom. The professional development facilitators, who included one of the authors of this paper, were experienced both in teaching science and in the facilitation of teacher professional development. During the programme, the UK facilitators supported the Ghanaian teachers to practise using the practical equipment and to plan how best to use it in Ghanaian classrooms. By the final instance of the programme, over 180 Senior High Schools had been equipped and around 1500 teachers had taken part.

A note about terminology

In this paper, we use facilitator to refer to any practitioner who delivers professional development activities to teachers. The term 'UK facilitator' describes members of the team of facilitators who were deployed by the Ministry of Education and ITEC Global to lead the professional development programme, and who identified and worked alongside the co-trainers. The 'co-trainers' are the particular cohort of Ghanaian facilitators who participated in this study. Using Margolis' (2012) terminology, the co-trainers are 'hybrid teacher leaders', that is, practitioners who maintain a teaching role while also taking on a role in leading the learning of other teachers. Participants are the teachers who take part in professional development programmes; the co-trainers were participants in one of the early cohorts of the programme described in this study, and in turn they became facilitators of professional development for other participants.

We have avoided using the term 'training' to describe the development of the co-trainers, although it is likely that this is how many within the programme would refer to it. Instead we describe the process they went through as learning and/or development; we make no distinction here between the terms professional development and professional learning, while acknowledging that a distinction is often useful (Boylan, et al., 2017).

Building capacity for professional development

In order to build greater capacity and sustainability (Haßler, et al., 2015) into the ongoing improvement of science teaching through professional development, a team of ten Ghanaian 'co-trainers' was identified from participants in the early phases of the programme. Identification of the co-trainers was based on their engagement with the programme as a participant, from their apparent confidence in supporting peers, understanding of the aims of the programmes and potential to take on the role of facilitator, and was agreed between the UK facilitators and Ministry of Education officials.

The aim was for the co-trainers to first work alongside the UK facilitators to run the programme, gradually taking on more responsibility to lead activities within the programme, and to later disseminate activities more widely to other teachers within and beyond their schools. The co-trainers would therefore become 'hybrid teacher leaders' (Margolis, 2012), maintaining their teaching role while leading the learning of other teachers. Below, we discuss the process of supporting the co-trainers to take on this role in more detail. An advantage of this cascade-type

model is the potential for increased sustainability of lower-cost in-country support and a reduced need for external expertise. Some co-trainers would also be tasked with organising professional development sessions, thereby adding another layer of leadership to their role (Boylan, 2016) and further reducing the need for external bodies to take on this role.

Cascade-type models of professional development are often used as way of reaching larger numbers of teachers for low cost (Bett, 2016), and can lead to successful capacity building (see, for example Macbeath et al., 2012, Swaffield, 2017). However they are not without flaws, such as the potential for dilution and misinterpretation of content with expertise remaining 'concentrated at the top' (Hayes, 2000) and, often, a lack of local expertise in facilitation (Kelani & Khourey-Bowers, 2012). The deployment of 'hybrid teacher leaders', although increasingly widespread, is also not without challenges in itself, such as the pressures of time and performativity on the teachers, who maintain their classroom role while taking on these additional responsibilities (Margolis & Doring, 2012). These models therefore often have less than the anticipated impact (Hardman, et al., 2011). While we acknowledge these tensions, our intention is not to comment on or evaluate the viability, success or impact of the particular cascade-type model in this programme; rather to explore the co-trainers' experiences as they took on the role of facilitator within the model.

The co-trainers, as they developed their knowledge and skills, were gradually taking on the role of professional development facilitator. We know relatively little about the roles and learning needs of facilitators, although a few studies have pointed to the complexity of the role, which encompasses multiple interlinking aspects including teacher, subject expert, facilitator, coach, mentor and critical friend (Krell & Dana, 2012, O'Dwyer & Atli, 2015, Higgins, 2008, Elliott, et al., 2009, Cordingley, et al., 2015). To be a facilitator therefore requires the deployment of various categories of knowledge and skills relating to each of these aspects of the role. We have previously suggested (Perry & Boylan, 2017) that the learning needs of professional development facilitators can be grouped into three categories: knowledge and skills for teaching (classroom pedagogical approaches, subject and curriculum knowledge), facilitation skills and knowledge (how to organise and support the learning of experienced teachers), and knowledge about professional development (theoretical and practical models of professional development, teacher learning and evaluation). In that previous study, we offered a model of learning for professional development facilitators. However, few other models exist in the literature (Elliott, 2005, Stein, et al., 1999) and those that do are based in high income countries with more established systems of education and, especially, of professional development. In low and middle countries, such as Ghana, there is little research to support understanding of what could work to build capacity for the facilitation of professional development.

In cascade-type models of professional development, the expectation is often that the existing facilitator (frequently from a different country) models the process of facilitating the programme and new facilitators pick up, with little explicit instruction or further support, how to carry out the role themselves (Hardman, et al., 2011). This process supports the new facilitators to learn new knowledge and skills for teaching, that is the content of the programme, but provides only implicit modelling of facilitation skills and knowledge and little in the way of understanding of professional development. This points to one reason why cascade models are relatively unsuccessful (Bett, 2016): the facilitators lack support to develop the appropriate knowledge and skills needed to deliver the programme.

By contrast, in this study, the Ghanaian co-trainers underwent an unusually prolonged period of support in learning about facilitation. Each co-trainer's experience was individualised, depending on the relationship with their UK facilitator, but broadly their development consisted of a gradual release of responsibility from the UK facilitator to the co-trainer over the duration of one or more iterations of the programme (Figure 1).

Figure 1. The co-trainers' experience

As an example, we describe Daniel's experience. Daniel was identified by a potential co-trainer as a result of his active engagement as a participant in the programme: he supported other participants, asked questions and indicated his enthusiasm for learning through practical and inquiry-led approaches. To begin his engagement as a co-trainer, the UK facilitator emailed him before the next instance of the programme to set out plans for the month's activities. He was asked to think about which activities or sessions he might feel comfortable to lead. He and the UK facilitator began to plan these sessions, to consider which other sessions he might lead and to share an overview of the whole programme. In planning, Daniel was able to draw on his own experience as a participant in the programme, on the 'course manual', which detailed all the practical activities from the programme, and on the UK facilitator's guidance. He discussed potential issues with the UK facilitator, such as how to manage the group of teachers, and worked alongside the programme's technician to ensure equipment was available. As well as planning his own sessions, he also supported the UK facilitator when she delivered other sessions. This part of his role included ensuring teachers understood how to carry out the activities, providing support and guidance, checking on equipment and offering suggestions of how to use the activities in the Ghanaian context. At the end of each day, Daniel and the UK facilitator jointly reflected on the effectiveness of the day's activities, considered any emerging issues for the following day and checked on plans for upcoming sessions. Early in the programme, Daniel facilitated single activities within a three-hour workshop led by the UK facilitator. Later, he took charge of longer time periods, until by the end of the programme he was managing full three-hour sessions. When he returned for the next instance of the programme, now an experienced co-trainer, he repeated all of these activities and took on the leadership of others, so that eventually he was planning and facilitating whole days of professional development.

Data collection and analysis

Institutional ethical approval was sought and obtained for this study. Consent was obtained from all co-trainers who were interviewed and, in keeping with consent, their names have been changed here for confidentiality. Given that one of the authors of this paper was also a UK facilitator in the professional development programme, some power and confidentiality issues arise. All conversations were therefore facilitated by the other author of this paper and all transcripts were anonymised before analysis.

The first two cohorts of the professional development programme ran in 2013 and 2014, involving around 240 teachers. From these, ten 'co-trainers' were identified by the UK facilitators. In 2014, interviews were carried out with eight co-trainers. By this time, each co-trainer being interviewed had been involved in at least two iterations of the programme, once as a participant and at least once as a co-trainer. The interviewees were those co-trainers working on the May 2014 instance of the programme.

Interviews, which lasted 45-60 minutes, used a storyline technique (Beijaard, et al., 1999) to explore the co-trainer's perceptions of their career to date, their understanding of professional development, of science teaching and learning in their schools, and their experiences of involvement in the programme. Participants were asked to draw and then describe a storyline graph of their career, highlighting points of high and low satisfaction and/or happiness. The storylines represented the co-trainers' reflections on a number of key experiences or events regarding their roles, on the vertical axis of a graph on a 5-point scale, and plotted in time on the horizontal axis (Figure 2).

Figure 2: Storyline technique

This technique stimulated reflective conversations and enabled the co-trainers to focus on critical points in the timeline, in particular on their experiences as part of the professional development programme and their role as a facilitator. Each conversation was audio recorded and transcribed for analysis.

Interview transcripts were analysed using an inductive process of coding and theming (Thomas, 2006) to understand the ways in which the co-trainers were learning about facilitation of professional development. We analysed the interviews for activities, actions and thoughts mentioned by the co-trainers as ways in which they were learning the role of facilitation, the impact these were having on their beliefs, knowledge and skills and in turn the influences of prior and current beliefs, knowledge and skills on their role as facilitator.

Findings and discussion

From the analysis of the co-trainers' experiences, four major themes emerged (Table 1): confidence, knowledge and skills for teaching, epistemological coherence and facilitation knowledge and skills. Below, we look at each theme in turn.

Table 1. Emerging themes

The co-trainers had a range of backgrounds, including employment in different types of schools, varied experience levels and differing school-based responsibilities. All themes were identified by more than one co-trainer, with all but one of the co-trainers indicating multiple ways in which they had learned as a result of participation in the professional development programme and/or through acting as a co-trainer. The one co-trainer who did not suggest any learning still provided useful information about his beliefs as a science teacher and his role as a professional development facilitator. Although we were not intending to evaluate the professional development programme, we did not ask the co-trainers to delineate between what they had learned as a participant and what they had learned as a co-trainer, and so there was some overlap in their discussions of these two aspects of their engagement with the programme.

Confidence

It appeared that being chosen from the participants in the programme to act as a co-trainer had a positive impact on the co-trainers' perceptions of their ability as a teacher. In turn, this increased their confidence as a facilitator of professional development. Rahman explained this:

I become confident when I came [as a co-trainer] for the programme. Very confident. Let's say I was noticed, like, "well this guy could be a good teacher. He could help others"... I felt really good.

Rahman recognised that this confidence could be an asset to a facilitator of professional development, since it offered credibility in the role of supporting others:

One thing I see to be very, very interesting is the type of confidence if you know what you're doing, if you do it correctly. Students, your colleagues, everybody likes it because you're confident, you understand what you're doing or you know what you're doing and you know where you're going to... my confidence has seriously developed.

Meanwhile, Daniel initially saw his role as a co-trainer as an opportunity to learn more about how to teach his subject, by participating for a second time:

My motivation was when I came for the second time – that is being the co-trainer – I could learn more and try to help build my confidence more in teaching and learning chemistry and in doing practicals... when you're a co-trainer you have the opportunity to learn again everything that you learn as a trainee so that if there were any misunderstandings going on in your head then you can understand it better.

As time went on, though, he realised that being a co-trainer meant more than simply being given an opportunity to participate in the programme again. He understood that being identified as a co-trainer was a recognition of his teaching abilities, and, in common with Rahman, this gave him more self-belief:

I liked it when [the UK facilitator] called me and I don't know why she chose me. She said I was special, but I didn't know that. She told me. I didn't know that... I liked it. It means a lot because I just do what I think I should do and it's good when people notice what you do and then they comment... It's very good.

Identification as a co-trainer therefore led to an increase in confidence and self-belief as a facilitator and as a teacher. An increase in self-belief is likely to lead to a feeling of increased empowerment (Wanzare & Ward, 2000), and this may be influential in teachers' resilience and in turn their career progression and retention (Gu & Day, 2007). The hybrid teacher role therefore offers a potentially valuable alternative pathway for teachers inclined towards leadership roles (Eckert, et al., 2016).

Knowledge and skills for teaching

Knowledge and skills for teaching are those needed for 'first order' practitioners (Murray & Male, 2005) to be effective in the classroom, that is the subject, curriculum and pedagogical content relevant to the teacher's role. In many professional development programmes, knowledge and skills for teaching form the substantive content to be learned by participants, so the facilitator needs to be familiar with and confident in their use (van Driel, et al., 2012, Margolis & Doring, 2013, Byington & Tannock, 2011).

Most co-trainers reported an increased understanding of knowledge and skills for teaching, specifically, the use of practical and inquiry-led approaches to science teaching. Not surprisingly,

repeated participation in the professional development programme increased the co-trainers' understanding further and this translated into their classroom practice. As Emmanuel said:

I try to find a practical for every topic and see if I can do it with the students... So now they're more interested...especially when they see colour changes in liquids. It makes them want to know more as to why things are happening

Daniel described how, as a result of the programme, he was using more practical activities than previously:

[following the programme] I did a lot of practicals... within that three months I did maybe four, five or six different practicals for my students and so they kind of like it now... So now they're more interested... Yes, it makes them want to know more as to why such things are happening. So now I do more practicals than before, yes.

The UK facilitators played an important role in modelling how to teach science using these practical-led approaches. Isaac described how he had directly transferred techniques learned from the UK facilitator to his own practice:

The way [the UK facilitator] handled things it was very interesting and lovely. I actually envied him and wanted to be like [him]....He's a good role model for me. It will surprise you to even know that I've adopted some of his styles in my in my classroom.

The co-trainers encountered some barriers to implementation of new teaching strategies. For example, Harriet revealed how, although she had learned new practical activities during the programme, the shipment of equipment had not yet arrived in her school, and so she was unable to put these new strategies into practice:

This high... this is where I came for the [training programme] first. That was a tremendous change, but there was a problem... When I shot to this height, although I had knowledge the items were not there to use. The equipment was not there to use.

Barriers to the implementation of learning from professional development are commonplace and well-discussed (for example Margolis, et al., 2017). It is notable that even co-trainers, who might be expected to be better equipped and more resilient than other teachers in dealing with challenges, felt this frustration in being unable to change their classroom practice due to structural and organisational barriers.

Even though this programme followed a policy-import model typical of low and middle income countries (Khalifa, et al., 2014), the positive impact we found on participants' practice suggests that the pedagogical approach of inquiry-led, practical-based science teaching is one which can transcend national contexts and cultural boundaries. We investigate this further next, in relation to the co-trainers' epistemological beliefs.

Epistemological coherence

All the co-trainers expressed strong beliefs in science teaching as a practical subject. During discussion of their storylines in the interviews, most co-trainers made it clear that they had held these beliefs since early in their careers, but, as mentioned above, were often restricted in their

enactment through a lack of equipment in schools. The value of practical work was described in varied ways, typifying its multiple and sometimes contested purposes (Abrahams & Millar, 2008). For example, Harriet explained how practical work can engage students:

Yes... Science is practical. It is practical. Without practicals science is just like an ordinary subject... if you give notes to students to read and write it's not science... Really when you want them to do it they're happy... They love it, they love practicals. As soon as they see a microscope they're mad... When I used a [microscope] to show them [cells] they were able to really see... and they were saying, "Oh! Oh!".. They love it. They love practicals.

Emmanuel explained another use for practical work: the learning of scientific concepts:

I think it's very, very important because it's hands-on activity and as the students do them they really are able to assimilate whatever concept that you're teaching them, and also whenever you want them to bring out information they can easily recall and tell you about whatever it is... It brings it very closer to them. It makes it very interesting too.

Participation in the programme reinforced these beliefs in science as a practical subject. Programmes aimed at improving science teachers' use of practical and inquiry-led pedagogies often include a consideration of teacher beliefs and understandings of the nature of science and science education (Loucks-Horsley, et al., 2010). We suggest that the degree to which any teachers' practice is transformed through professional development depends on how these epistemologies are formed and challenged, so that teachers can identify and reflect on how best to support their students' learning. This in turn depends on the epistemologies of the professional development facilitators leading the learning; indeed, this may be a crucial factor in the success of any professional development.

We suggest that, in our study, the co-trainers' epistemological beliefs were an influencing factor, whether consciously or unconsciously, in the UK facilitators' identification of the co-trainers. These beliefs about how science should be learned aligned with the aims of the professional development programme from the Ministry of Education and with the beliefs both implicit and explicit in the UK facilitators' delivery of the programme. However, in other professional development programmes this epistemological alignment may not be present, and this may provide a useful explanatory factor in programmes which have limited impact, especially where there are policy-imports and cascade models (Bett, 2016).

Facilitation knowledge and skills

Facilitation knowledge and skills are the 'second order' (Murray & Male, 2005) strategies used to organise the learning of a group of teachers. These encapsulate the ways in which professional development is different from teaching, including the ability to shift between multiple roles (Lange & Meaney, 2013), to model practice explicitly (Borko, et al., 2014), support teacher reflection (Solomon & Tresman, 1999), elicit prior experience from the teachers (Ince, 2016), and, as identified by one of the co-trainers in this study, to extend differing levels of freedom to teachers compared to students in the classroom.

The co-trainers were often explicit in describing what they had learned in this theme, which were usually strategies or techniques modelled by the UK facilitator. For example, Isaac described how he had noticed the UK facilitator reminding teachers to make notes of their learning:

That is one thing I've learned from [UK trainer] – to record... He will say, 'write this thing down because in six months' time you will not remember it', and I totally agree with him. So it's the same thing for other teachers.

Other co-trainers identified ways in which working with teachers was different from working with students. This knowledge did not necessarily derive from observation of the UK facilitator but rather through reflection on how they should act when facilitating their own sessions. For example, Felix reflected on the greater level of subject knowledge of teachers compared to students and how this would lead to a different approach:

Teachers, I think they have a certain level of understanding of science, some theoretical understanding so that it's easier to take them through a lot more experiences and at a greater depth than I would with students.

Emmanuel explored the differences between teachers and students from the perspective of managing their learning, revealing that, in his view, that it is possible to allow more freedom, variation and interactivity to teachers than to students:

Adults can easily adapt to the situation and environment in which we are working than the students. Some of the students are very naughty. Even if you tell them not to go close they like to see the reason why you say they shouldn't go close... but the adults can easily adapt... [With teachers] sometimes there is a little bit of teaching. Especially with this place there is a little bit of teaching and then sometime you tell them or you demonstrate an activity that you want them to do... sometimes if someone is going wayward you'll not directly say what you're doing is wrong. You might ask, "why did you do it this way? Why didn't you do it the other way?" ... So sometimes it's more interaction than teaching... This place is not like you're just imparting knowledge to them.

We have already mentioned credibility in relation to the co-trainers' confidence. Within this theme, we identified some potential concerns within the co-trainers' beliefs in their credibility as facilitators. For example, Kofi discussed the potential for variability in teachers' responses to his sessions based on their own professional experiences:

I may be a trainer, but I'm also a teacher just like them, so they see it like whatever I know they also know... some of them feel they know already, so their attentiveness will not be that much... that is where the difficulty will come. But others are eager to know the different angle you're bringing and just go and make the class interesting and exciting. So for the teachers it's dicey and I can't be so certain on how the class will be.

Further, Daniel identified his own subject knowledge as a potential area of perceived weakness in comparison to other teachers:

You cannot founder in front of teachers. You cannot do that. They have to believe you. So if they have to believe you it means you have to know more, a lot, lot more because most

of them know a lot. And me, for instance, I've done only a first degree and a lot of them have done a second degree, so academically they're a bit above you and you should have an idea of what they've done.

These concerns about credibility reflect other studies where teachers take on second order roles, such as when becoming a teacher educator (Murray & Male, 2005). Often, when individuals make this transition, there is limited support to develop skills, confidence and a changing professional identity (see, for example, Swennen, et al. 2008). In contrast, in our study, the co-trainers underwent an extended experience of learning facilitation knowledge and skills. In these early stages of their development as facilitators, they were considering how best to structure sessions and engage the participants; they appeared to be less concerned with the outcomes of professional learning. In this regard, their learning appears to parallel a well-documented – although not universal (Levin, et al., 2009) – route for novice teachers, in which there is a gradual shift, with experience, from a focus on the self through a focus on the content of the activity to a focus on student learning (Kagan, 1992).

It is not clear whether the extended period of support from the UK facilitators led to any greater learning about facilitation than shorter periods of development. However, it is apparent that the co-trainers gained beneficial learning about the facilitation of professional development through their work alongside the UK facilitators. Therefore, these opportunities to learn through observation of experienced colleagues and to trial strategies in a supported environment appear to be valuable in the development of facilitators' expertise.

Conclusions and implications for practice

In the programme which forms the basis of this study, the aim was to support teachers in Ghana, a middle income country, to use a particular pedagogical approach: an inquiry-led, practical approach to science teaching. To help them learn about this pedagogy, they participated in a professional development programme led by facilitators from the UK, supported by Ghanaian co-trainers. Our findings suggest that this particular pedagogy transcends, or at least is not restricted by, contextual differences between Ghana and the UK. Not all policy imports, therefore, are likely to fail; some may successfully cross boundaries. Further research would be useful here to understand what types of pedagogical approaches have the potential for international transfer and which models of professional learning can support this most effectively. We suggest that practitioner research models of professional development offer a potentially useful tool here since they enable teachers to explore and make explicit their epistemological beliefs (Qhobela & Moru, 2014).

In this study, epistemological coherence was inherent in the co-trainers' beliefs about science teaching and was enhanced by their prolonged engagement in the programme, through participation and facilitation working alongside the UK facilitators. In this way, they had a better understanding of the programme's aims and pedagogical approaches, before taking on the role of sole facilitator. We propose that if the epistemological beliefs of the facilitators do not align with those of the programme, then the professional development is likely to have much lower impact. This may explain the apparent failure of many cascade-type models (Bett, 2016). Leaders of professional development programmes need, therefore, to ensure that facilitators are given opportunities to explore, understand and align themselves with the pedagogical and theoretical principles of their programmes.

As the co-trainers in this study developed their understanding of their role as facilitators, they learned knowledge and skills for teaching and facilitation knowledge and skills. We suggest that it is important for all new facilitators to be given opportunities to learn about these aspects of their role. In this study, the co-trainers' learning derived from their multiple roles as participants, observers, assistants, co-facilitators and ultimately facilitators. This model of capacity building, with a gradual release of responsibility, has applicability more widely. In particular, for low and middle income countries, this model may provide a way in which external agents can share and then devolve their expertise to in-country facilitators with better understanding of local contexts, thereby offering the potential for greater impact of professional development on teachers' practice.

In a previous study (Perry & Boylan, 2017), it was proposed that professional development facilitators may also benefit from learning knowledge of professional development, including understanding theoretical models of how teachers learn, models of professional development such as practitioner research strategies and models of evaluation. Other studies have also shown that expert facilitators draw on this type of knowledge (Cordingley, et al., 2015). However, in this study, we did not identify any learning in this category. Perhaps there was little opportunity for this type of learning to take place: because the programme's structure and evaluation were pre-determined by the Ministry of Education and ITEC Global, there was no reason for the UK facilitators or co-trainers to consider these aspects of their role. However, in other programmes of professional development, this may not be the case and in these there may be value for facilitators to consider models of learning and evaluation. Further research is needed here, in order to explore whether and how learning about professional development contributes to facilitators' effectiveness, and, if so, how to support facilitators to develop this understanding.

As the co-trainers took on the role of facilitator, their confidence increased. This gave them more self-belief in their credibility as a facilitator, and, interestingly, more confidence in their teaching ability. This suggests a useful driver for educational leaders: by providing opportunities to develop as a 'hybrid teacher leader' (Margolis, 2012), teachers may be more likely to stay in the profession. However, there remains a challenge in ensuring that teachers taking on these hybrid roles are given sufficient support within the system to effectively fulfil their roles.

In conclusion, this study shows that taking on the role of professional development facilitation provides a useful increase in confidence for teachers. We have identified a potentially important success factor in cascade-type models of professional development: the epistemological alignment of facilitators with the inherent aims of the professional development programme. We offer here a model of capacity building for professional development facilitation which supports learning about teaching and about facilitation, which has applicability to low and middle income countries in particular and may be effective in other contexts.

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