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REMPE-GILLEN, Emma <http://orcid.org/0000-0001-9190-2154>

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Primary School Teacher Experiences in Cross-Phase Professional Development Collaborations

Emma Rempe-Gillen

Sheffield Institute of Education, Sheffield Hallam University, Sheffield, UK, S1 1WB

e.rempegillen@shu.ac.uk

Teacher collaboration, and teacher professional development within this context, has become an area of interest in recent years. In particular, teacher education has seen the rise of collaboration as an effective school-based professional development activity, where in-service teachers plan, observe and reflect on lessons together. The most common form of teacher collaboration is between teachers within one school or department; however, in England networks do exist that involve teachers from different schools (cross-school). Of the small number of collaborations that do extend beyond a single school, few involve teachers from different age phases (cross-phase), and only a very small number of these involve teachers planning lessons together, observing and jointly reflecting on teaching practice. This article analyses and discusses the experiences of two primary school teachers in a cross-school and cross-phase collaborative year-long innovative initiative to speculate about the implications of this type of professional development. Specifically, I examine whether cross-phase and cross-school collaboration affords primary school mathematics teachers opportunities to develop and addresses what hinders their participation. Implications for future research on primary school teacher collaborative professional development are discussed.

Keywords: professional development; primary school teacher; cross-school initiative; cross-phase initiative; mathematics; collaboration

Introduction

Teacher collaborations have become a common mode of professional development in recent years. Internationally teacher education has seen the rise of collaboration as an

effective school-based professional development activity, where in-service teachers plan, observe and reflect on lessons together (e.g. Japanese Lesson Study). In England, collaboration has traditionally existed in groups of teachers within one school or department. Research by the National Centre for Excellence in the Teaching of Mathematics (NCETM, 2009a) into effective continuing professional development (CPD) in England and Wales found very few collaborations that involved teachers from different age ranges (phases) and different schools. Today, teacher collaboration across schools (cross-school) and age ranges (cross-phase) is not only unusual in the UK, but there is very little evidence in the literature to suggest that it is a model of professional development used elsewhere in the world. This article explores the experiences of two primary school mathematics teachers who participated in a professional development collaboration with secondary school teachers in a year-long cross-phase and cross-school initiative.

Background

This section presents a brief overview of collaborative professional development and discusses how a cross-phase and cross-school setting can provide opportunities for teacher collaboration.

Collaborative professional development

The National Centre for Excellence in the Teaching of Mathematics (2009a) identifies three categories of teacher development activities: courses, within-school initiatives and networks. In addition to these, Joubert and Sutherland (2008) identify self-study, mentoring, coaching and teacher enquiry. Courses "tended to introduce new ideas and knowledge and some courses focused on specific areas of mathematics knowledge for teaching" (National Centre for Excellence in the Teaching of Mathematics, 2009a, p.

25). They are also specific in participant goals, with a top-down approach, and commonly resulted in some sort of accreditation. Within-school initiatives tend to focus on a department or subgroup of school staff "working towards the goal of adopting a common approach" (p. 27). Again there is a specific goal, though it is relevant to the individual context in which the teachers work. Networks involve teachers from different schools and are different from courses in that they are on-going and of a more 'supportive' nature. One is described as having the intention that "practitioners should 'own' their CPD" (p. 28) and another "aimed for teachers to support one another in embedding new learning" (p. 29).

Krainer (2003, pp. 94-95) observes that an increasing number of research papers on teacher development - he uses the term 'teacher education' - refer to "some kind of 'communities'" where teachers collaborate with each other in a development environment. He cites examples of Hammerman's (1997) 'teacher inquiry groups', Birchak et al.'s (1998) 'study groups' and Wenger's (1998) 'communities of practice' alongside his own 'network of critical friends' (Krainer 2001). Communities are differentiated from teams and networks on the basis of them being 'self-selecting, their members negotiating goals and tasks' where 'people participate because they personally identify with the topic' (Krainer 2003, p. 95). Teams, he describes, are 'mostly selected by management, have pre-determined goals and therefore rather tight and formal connections within the team'. Networks are 'loose and informal because there is no joint enterprise that holds them together. Their primary purpose is to collect and pass along information' (2003). Krainer's (2003, p. 95) notion of community correlates with Wenger's (1998) 'community of practice', which has three dimensions: mutual engagement, a joint enterprise and a shared repertoire. This clearly overlaps with the professional development literature of contextualising effective CPD, making it

meaningful and beneficial to the teachers by having them decide the joint venture based on their own contexts.

Cordingley et al. (2005a, p. 2; original emphasis) define collaborative CPD as 'programmes where there were specific plans to encourage and enable shared learning and support between *at least two* teacher colleagues on a sustained basis' where 'sustained' refers to programmes which 'were designed to continue for at least twelve weeks or one term'. The National Centre for Excellence in the Teaching of Mathematics (2009a) descriptions of within-school initiatives and networks suggest that these can be classed as collaborative activities. Of the collaborative CPD initiatives in the National Centre for Excellence in the Teaching of Mathematics (2009a) report and the Cordingley et al. reports (2003, 2005a, 2005b) - a total of 47 - it is not evident that any involve all teachers within a cross-phase and cross-school CPD collaboration. The National Centre for Excellence in the Teaching of Mathematics (2009a, pp. 28-29) networks focus around face-to-face meetings where teachers 'networked' and report back on their work in the classroom. There is no evidence that the teachers plan activities/lessons together, observe each other, give feedback or have an ongoing professional dialogue in between meetings. Of the two initiatives defined as cross-phase, the first is in-school, and the second involves primary and secondary teachers. This second initiative again focusses around meetings and does not involve teachers collaborating. Collaboration happens, but it is within each school, with school representatives then attending the meetings. A project funded by the National Centre for Excellence in the Teaching of Mathematics (2009b) researched two cross-phase and cross-school groups and involved teachers' planning lessons, peer observation and discussion of their teaching practices. This is a sustained collaboration with teacher-researcher collaboration conducted face-to-face and augmented with email contact. It

raises the potential of cross-school and cross-phase collaborations with technology enabling ‘virtual' meetings and remote peer observation, which became the basis of my PhD research (Rempe-Gillen 2012).

The current drive for collaborative professional development

Particular styles of collaboration have come to the fore; most notable in mathematics education is Lesson Study, which originates in Japan. This practice, which involves teachers jointly planning a lesson, followed by group observation and review of the lesson, or research lesson, has been a common form of professional development for Japanese mathematics teachers for decades. A similar style of collaboration, though from China, is *Keli* (Huang & Bao, 2006) which centres on teachers and researchers designing an ‘exemplary lesson’ through joint planning, teaching, observation and refining. A third example is in South Korea where, given the size of primary schools and number of teachers who teach the same grade (e.g. four teachers may each have a class of twenty students in one grade) teachers can plan lessons and observe lessons. Upon revision, another teacher can then teach the same lesson but to a different class in the same grade.

Only recently have educators in other countries looked to utilise these forms of collaboration as professional development for teachers in countries such as the United States and England. Collaborative professional development has become central to the professional development of mathematics teachers (for example, see Fernandez and Yoshinda, 2004 and Lewis et al. 2009). In the United States, Fernandez (2002, p. 393) notes that Lesson Study is supported by numerous American educators, perhaps because it ‘represents an example of a systematic and well-articulated process of examining practice that has no equally well-developed counterpart in the United States’,

and it is incorporated into secondary school mathematics teacher education programmes in some states, such as New York State. Elsewhere, governments and educational reviews are driving the concept of collaborative professional development. For example, in England the Standard for teachers' professional development (Department for Education 2016, p. 9) states that professional development 'should include collaboration'; the Donaldson Review of teacher education in Scotland (Donaldson 2011) emphasises collaborative development and the Welsh review, 'Teaching Tomorrow's Teachers' (Furlong 2015, p. 6) identifies the need for teachers to work collaboratively 'in the development of their own practice'.

Benefits of collaborative professional development

The benefits of professional development in a sustained collaborative setting have been shown to far outweigh the one-day courses which many teachers experience as professional development. Cordingley et al (2003), in reviewing research papers on collaborative CPD, reported findings in terms of teachers, students, the process of CPD and research into CPD. From working in collaboration, teachers are found to have greater confidence, have enhanced beliefs in their power to make a difference to pupils' learning, develop enthusiasm for collaborative working, develop a greater commitment to changing practice and willingness to try new things and develop a wider range of learning activities and strategies for students (Cordingley et al. 2003, pp. 4-5). As a result of these developments, the report collates the changes seen in students; including the appearance of an increased motivation, improvement on tests, better organisation of work and more sophisticated responses to questioning (p. 5). From the research on the benefits of collaborative professional development it is clear that it can only support the

development of teachers to provide as many opportunities for collaboration as possible.

The potentials of collaborative professional development in a cross-phase and cross-school setting

For teachers working within the same school or within one department, such as a secondary school mathematics department, the potential for collaboration and shared interests is apparent. Teachers need to perceive that any CPD initiative they participate in is relevant to them for it to be effective (for example, Leiberman 1996) and obviously collaborating with teachers from the same department or school provides a shared context. To create a collaboration outside the boundaries of one school the cohesive bonds and relevant factors of the group need to shift from geographical location and/or shared pupils. On closer examination of the success of Lesson Study in Japan we can see that this contextualised professional development is dependent on the organisation of the national education system. Japan's centralised educational system and national curriculum, where teachers throughout the country teach to the same learning objectives, are reasons considered for the success of Lesson Study since this establishes a common goal for collaboration (Stigler and Hiebert 2009). In England teachers also work within a national curriculum where there are common learning objectives and, furthermore, there is an overlap in curricula of the upper primary school (Key Stage Two) and the lower secondary school (Key Stage Three). This overlap of curricula thereby can provide a basis of collaboration for lessons to be jointly planned, taught and reviewed by teachers based not only in different schools but who teach different phases.

Context of the study and research focus

This article details some of the outcomes from my PhD thesis, which was a larger study focussed on the use of technology and professional development in cross-school and

cross-phase collaborations. The year-long study was a co-operative intervention (Krainer, 2003 p. 98), because it encompasses both the practice of professional development and the research of professional development. Therefore, the research involves a mixture of researcher and teachers' influences, including the focus of teacher use of technologies in a mathematical context and a collaborative setting, yet dependent on the technologies which the teachers chose influenced by what they perceived to be of benefit to their contexts. A case study approach is utilised since the setting and research focus is particularly unusual and this methodology allows the 'study of the particularity and complexity of a single case, coming to understand its activity within important circumstances' (Stake 1995, p. xi). In particular, the research is a collective intrinsic case study (Stake 1995) because a multiple case study approach allows for understanding about particular cases for their own value – how these particular teachers collaborate and use technology - not as a way to generalise. It is also an embedded multiple case study (Yin 2009) because the groups of teachers are studied on two levels: first, their professional development; and, second, an analysis of the role that technology plays in their collaborative development.

Given the atypical setting of this research a nationwide search of existing groups of cross-phase and cross-school teachers proved unfruitful. The research groups were created for the study from teachers who responded to the nationwide search expressing a willingness to collaborate in such a group. As the year-long data collection period progressed it became evident that the experiences of two primary school teachers - working in different teacher groups - were significantly different and this became a sub-focus of the project, and the focus of this article. Specifically, the article demonstrates how a cross-phase and cross-school setting can provide professional development

opportunities for primary school teachers and address the potential hindrances which may be encountered.

Methodology

A nationwide search for established cross-phase and cross-school collaborations proved unfruitful. However, it did identify 39 teachers from 21 local authorities across England who were interested in participating in such collaborations. From these, 11 primary school teachers and seven secondary school teachers were grouped into seven cross-phase and cross-school collaborations, where only one group involved teachers who knew each other. Given that the research intended to study a unique, specialised group of teachers - namely from Key Stages Two and Three; interested in working in a cross-phase and cross-school collaboration; and focused on using technology in mathematics education - there was much uncertainty in recruiting and retaining the groups for the academic year. The loss of one teacher from the research could - and did - cause the collapse of groups if s/he was the only teacher from that phase in the collaboration.

The primary school teachers

This article highlights the experiences of two primary school teachers from two of the seven groups, Kirsten and Wendy[i]. They were chosen because their groups sustained for over six months and their experiences were significantly different.

Both Kirsten and Wendy were experienced primary school teachers. Kirsten was in her seventh year of teaching and Wendy her 15th year, and both teachers were curriculum coordinators for mathematics in their school. Previously, they had worked with other primary school teachers, both in their own school and other primary schools; however, this had always been in roles where they had been in a leadership position of

providing training to other primary school teachers. Neither Kirsten nor Wendy had worked in a peer collaboration before and they had never jointly planned lessons with colleagues, other than as a training exercise when in training themselves or when training new teachers. For this research, they were each paired with a teacher who worked in a nearby secondary school.

Instruments

Three data collection tools were utilised:

- *Interviews*: Fontanna and Frey's (2003) semi-structured interviews allow for a set of starter or topic questions, with the flexibility to ask further questions for clarification or exploration, to follow up information given by the teachers. Interviews were conducted at the beginning and the end of the project, and were audio recorded and transcribed. The initial interviews consisted of starter questions to gain insight into a range of issues, such as the teachers' teaching backgrounds; motivation for participation; experience of collaborations; and experience of using Information and Communication Technology (ICT). The final interview topic questions covered the teachers' recollections of their participation, perceived effects of participation, and comparisons with other CPD activities.
- *Participant-observation*: as the facilitator of the CPD, I participated in the collaboration and activities the groups engaged in. In particular, data were collected from teacher meetings, which were audio recorded and transcribed.
- *Documentation*: email correspondence, computer-mediated communication and field notes were included[ii].

Analysis

The teachers' development within the collaborative group was the basis of all analysis,

because cross-phase collaborative professional development cannot be termed as such if no development occurs. Given the intrinsic and enlightening nature of the case study it was not immediately evident what the specific outcomes of the research were likely to be, so a grounded approach to the analysis was taken. The analysis was structured in terms of the teachers' and the collaborative groups' journeys and experiences, and the research questions were addressed within these journeys. Data analysis involved repeated readings of field notes, interview and meeting transcripts, and discussion and journal entries. From this, each groups' and individual teacher's "story" emerged (Stake 1995, p. 127).

Data analysis started with the first data collected, the initial group meetings and email correspondence. From reviewing each of these in-depth similar phenomena were similarly labelled or coded in NVivo. From the focus of my data collection, (e.g. interview questions), there was an initial model of categorisation based on the particular issues in this study. Examples of these categories were the teachers' context and their previous involvement in collaboration and working with colleagues. From this starting point of initial categorisation began the detection of patterns and themes that continued as more data were added to the data-set. A summary of the salient features of each group, following the initial meetings and interviews, led to further insights into the data. By moving from one piece of collected data to the next, throughout the year, tentative relationships emerged that could be verified, or refined, in the light of new data.

Two of the themes to emerge from this iteration of analysis and re-coding were the teachers' views of primary school and secondary school education and the influence of the other teacher in the group. From this analysis the affordances and constraints offered to primary school teachers in a collaborative setting can be investigated.

Kirsten and Wendy's cross-phase and cross-school experience

This section details the experiences of Kirsten and Wendy as they engaged in the cross-school and cross-phase collaboration. Detailed are their motivations to participate, their activities and how they overcame obstacles along the way.

Kirsten's cross-phase and cross-school pairing

Kirsten responded to the nationwide search for teachers after being informed of it by her headteacher. She was paired with a teacher who had responded to the search for teachers via her local authority mathematics advisor. Kirsten did not know the secondary school teacher, although the two schools were in the same local authority. However, the pupils from the primary school did not typically go to the secondary school - the primary school was not a 'feeder' school for the secondary school.

Kirsten was the mathematics coordinator for her primary school and the secondary school teacher was the primary mathematics liaison teacher in the secondary school, particularly interested in mathematics transition from primary to secondary school. Therefore not only was there a common ground with the national curriculum teaching objectives, both teachers were very interested in the teaching and learning of mathematics.

Over the three terms of the academic year, Kirsten's pair worked in a linear way. After deciding to use the technology Geogebra[1] in the teaching and learning of mathematics the two teachers focused on learning Geogebra themselves and then they each planned and taught a mathematics lesson using Geogebra. There were

[1] Geogebra is free software for teaching and learning mathematics, http://www.geogebra.org

opportunities to discuss the preparation of the lessons, observe the lessons and discuss the lessons afterwards.

At the start of the academic year, the teachers agreed that the secondary school teacher would teach her research lesson first and - depending on when she could arrange for her pupils to use a computer room for the lesson - she would inform Kirsten of which topics she could teach, based on her school's scheme of work. This would give them the opportunity to discuss the preparation of the lesson together. Unfortunately, the secondary school teacher was unable to arrange a computer room in the first school term so Kirsten planned and taught the first Geogebra lesson in the second term using a set of laptops in her classroom. Surprisingly, even though both teachers had the opportunity and means to jointly plan and observe each other's lessons - and were encouraged to do so – Kirsten opted to plan her lesson by herself. The secondary school teacher asked for Kirsten's lesson to be recorded so she could view it but she was unable to do so before the group met to discuss Kirsten's lesson.

The secondary school teacher subsequently taught her research lesson and, although she asked Kirsten for her input and wanted to jointly plan the lesson, Kirsten chose not to engage with planning the lesson. The secondary school teacher was left to plan her lesson alone; however, Kirsten did observe the recording of the secondary teacher's lesson and engaged in a discussion of the lesson afterwards.

Wendy's cross-school and cross-phase pairing

Wendy already knew the secondary school teacher in her pairing; in fact, it was the secondary school teacher who had informed her about the research project, following the nationwide search, and asked her to participate. The secondary school teacher had known Wendy for about a year before the research project started. This was following a

visit by Wendy to the secondary school, because pupils from Wendy's primary school typically went on to attend that secondary school. The two of them had since worked together on a mathematics transition project, designing lessons for all the primary schools which fed pupils into the secondary school to use in preparation for the transition.

Wendy's pair chose to use Bowland Maths[2], in particular the Alien Invasion case study. The secondary teacher suggested this because she thought the story of an alien invasion would engage pupils and because it was a series of lessons which did not require pupils to use a computer, since this was not possible in the primary school and would mean arranging lessons based on the availability of computer rooms in the secondary school.

The Alien Invasion case study materials include the lesson plans and resources for four mathematics lessons. The secondary school teacher taught all four lessons to a class of year eight pupils (second year of secondary school). Then she taught the same four lessons to a group of years five and six pupils (last two years in primary school) who had travelled from the primary school to the secondary school for the research project. Wendy did not anticipate using Bowland Maths in her own primary school teaching so she chose to support the primary school pupils by working with them in between the research lessons on mathematics topics that she felt they did not know or which they needed to revise. In preparation for when the secondary school teacher taught the lessons to Wendy's primary school pupils, Wendy methodically worked through the lesson plans by herself, considering if anything needed to be changed for

[2] Bowland Maths Case Studies are prepared ICT teaching materials for teaching and learning mathematics, www.bowlandmaths.org.uk

her pupils to access the material. Furthermore, Wendy observed the secondary school teacher's four lessons with the year eight pupils on DVD so she could see the case study being taught. Following the year eight lessons the two teachers met to discuss the lessons and Wendy shared her thoughts on how the lessons might be altered when they were taught to her primary school pupils. For the primary school pupils' lessons, which were held in the secondary school, the secondary school teacher taught the first three and Wendy taught the fourth when the secondary school teacher was absent from school. Both teachers sought feedback on Alien Invasion lessons from their pupils and the positive responses encouraged them to consider using Alien Invasion and other Bowland Maths case studies in the future. Indeed, on one occasion following the research project, Wendy was asked to cover the teaching of an absent teacher at short notice and she chose to use material from the *Alien Invasion* lessons over the course of a whole day.

Kirsten and Wendy's experience of collaborating with a secondary school teacher

Kirsten and Wendy experienced similar cross-phase and cross-school collaborations in that they were both paired with an experienced secondary school teacher, they planned and taught a mathematics lesson as part of the project and they engaged in some opportunities to discuss the teaching and learning of mathematics. However, their views of their experience were quite different from each other, particularly with regards to their reflections on working with a secondary school teacher.

Wendy believed that the secondary school teacher she worked with took consideration of her mathematics ability and this was a major contributing factor to why their collaboration was successful. She wanted to be viewed as a teacher of mathematics as well as a primary school teacher, but she thought that a secondary school teacher

would not usually consider her mathematical ability; however, the secondary school teacher she worked with did:

> To see me as a person that actually knows something about maths, rather than just a primary school teacher. And I think sometimes, and certainly not [the secondary school teacher], but sometimes when I've spoken to maths teachers at [the secondary school] I'm just a primary school teacher and yet my passion is maths and a lot of my degree is in maths and things like that. So it's not that I've no mathematical background. (Wendy)

In contrast, just the fact that Kirsten was working with a secondary school teacher was influential and this became more apparent as the project progressed. Kirsten mentioned her own mathematical qualifications on a few occasions throughout the year and in her final interview revealed that she had felt self-conscious about her mathematics ability because she perceived it to be inferior to that of the secondary school teacher. Whilst talking about this, she recounted a number of negative mathematical experiences, such as the difficulties she had learning mathematics at secondary school, her father's influence as a secondary mathematics teacher and her son's negative comments about her not being able to remember the multiplication tables. Throughout the project Kirsten did not recount any positive experiences of learning mathematics and did not evaluate her knowledge of mathematics positively. It was evident that her previous negative experiences led her to feel insecure when discussing mathematics in the group and she was worried that what she perceived to be her lack of knowledge would be viewed negatively by the secondary school teacher and me (a former secondary school mathematics teacher). Therefore, she held back from participating in any mathematical discussions:

> I think that that's my maths knowledge and, like, being afraid that you'd somehow notice that I wasn't as strong as [the secondary school teacher] at maths [...] because I knew you were high up in maths so I thought ... well actually I felt a bit insecure about that. I felt a bit insecure about the fact that you would suddenly see me as a fraudster but knowing that she obviously has a specialism in maths as well, I was really reluctant to talk about anything mathematical in those meetings at all because I actually thought if I say something wrong here, try and join in and say something wrong you're both gonna know and be too polite to say. So I just thought 'I'm just going to say nothing mathematical or as limited as I can' and I was really on the back foot with it. (Kirsten)

Furthermore, when Kirsten did discuss mathematics, such as when she spoke about the lesson she taught, she specifically chose the topic - perpendicular and parallel lines - because she was very confident with it:

> I thought 'I'm really secure with this. They're [the pupils] insecure with this. I can really do something with this.' I was really happy. (Kirsten)

In the final interview, Kirsten asserted that she would have felt insecure with any secondary school teacher compared with how she would have felt talking about mathematics with other primary school teachers:

> 'Cos we'd all would only teach up to [national curriculum] level five and you'd find if you interviewed a lot of primary teachers you only learn, you only rehearse what you have to teach. (Kirsten)

In both cases working with a secondary school teacher was influential in how the cross-phase and cross-school collaboration progressed. For Wendy, she actually wanted to be part of a mathematics project because she thought secondary teachers did not always view her as a mathematics teacher. On the other hand, for Kirsten she did not want to be viewed as a mathematics teacher and her self-efficacy influenced how she engaged with the other teacher and she refrained from discussing mathematics.

Discussion and conclusions

On closer inspection of the professional growth of the two primary school teachers the influences on their development can be analysed. Specifically the research identified subject knowledge, working with secondary school teachers, opportunities for experimentation, teacher characteristics and leadership as influences in cross-phase and cross-school collaborations. These influences are complex because they offer both affordances and constraints to professional development and therefore participants need to be aware of their potential influence.

Professional growth

For Wendy, her participation in the project and observation of the secondary school teacher' lessons augmented her knowledge and she saw the value of using Bowland Maths with her pupils as a transition activity led by the secondary school teacher. She was involved in the planning of the primary school lessons with the secondary school teacher even though she did not intend to teach any of them, only teaching the final primary school pupils' lesson when the secondary school teacher was absent from school. Wendy's lesson preparation involved information that had been discussed in an earlier meeting with the secondary school teacher and she garnered feedback from her pupils using a similar response sheet to that used by the secondary school teacher. The feedback focussed on her pupils' enjoyment and learning, which informed her of value of the resource and her increased her confidence in using it. After the project lessons had finished she used *Alien Invasion* with pupils in her primary school, clearly demonstrating how the collaboration had led to her confidence and professional development.

For Kirsten, her knowledge of Geogebra came from the training session at the start of the project, her discussions with the secondary school teacher and her internet searches. These also informed how she would use Geogebra in her lessons, which she then taught. She considered how her pupils had used Geogebra, their enjoyment in using it and their ability to complete the tasks that she had designed, and she compared this with other software that she used in lessons. She also reflected on her own performance, how she manipulated the objects on screen and the ease of using Geogebra compared with other software that she knew about. Her reflections on these aspects of the use of Geogebra informed her decision of whether she would use it again.

Opportunities for experimentation

The school context influenced both primary school teachers in terms of the opportunities they had for lesson experimentation. It is possible that the transition aspect of the collaboration that Wendy worked in gave weight to her participation and therefore the school supported her participation in the project. One example of this school support was the transportation of Wendy and the primary school pupils from their school to the secondary school on four afternoons, so that the primary school pupils could be taught in the secondary school. Another example of school support was that Wendy's school provided teaching cover for her lessons so that she could leave the primary school to participate at the secondary school. In contrast, Kirsten and her paired secondary school teacher had time constraints and they both acknowledged that their participation was lower on their list of priorities than work in their own schools. Kirsten viewed her participation as additional to her school role and her school did not provide the same level of support as Wendy's school did. Furthermore, none of the four teachers reported on here had their participation in the research project recognised as part of their

performance management process, which for Kirsten may have elevated the status of her participation.

Leadership of the collaboration

Wendy and Kirsten both held positions of responsibility in school, including mathematics coordinator. However, when a leader emerged in the groups for Wendy's paring it was the secondary school teacher and in Kirsten's group it was Kirsten. Although Wendy was a very experienced teacher who held leadership positions in her school it was the secondary school teacher - who had previously held the position of head of mathematics in a different secondary school - who emerged as the leader. The secondary school teacher made a number of key decisions in the project and Wendy enabled her to take control of the group. Examples of this were the secondary school teacher's choice of *Alien Invasion* and the number of primary school pupils who would be involved in the project. For the secondary school teacher, the use of Bowland Maths as a mathematics transition activity was central to the project and her view led the pair to focus on this. On the other hand, Kirsten emerged as the leader in her group and her aversion to joint planning and discussing mathematics resulted in the teachers not collaborating. Even when the secondary school teacher asked Kirsten for her input, when she was planning her lesson, Kirsten refused.

Subject knowledge

The role of subject knowledge influenced both primary school teachers during the project. Wendy was very engaged with the project because it involved mathematics. In fact it was one of the reasons she had participated and she was very motivated. In contrast, Kirsten's headteacher had asked her to participate in the project because she was seeking promotion, so she was not involved because of the mathematics element

even though she was the school's mathematics coordinator. Kirsten's perception of her own mathematics ability led to her avoidance of participating in mathematical discussions and she evidently felt more confident discussing other subjects. For example, she was also the school science co-ordinator, and she initially spoke about using Geoegbra to teach science. Considering this, it is possible to speculate that she would have engaged in collaboration for a science project. However, the evidence suggests she would not have collaborated on a science project either. Kirsten emerged as the leader in her group and her aversion to joint planning of lessons, influenced by her own negative experiences of the subject at a level higher than primary school, impacted on how she collaborated with the secondary school teacher. This view of her mathematics ability relates to mathematics self-efficacy and anxiety.

Hackett and Betz (1989, p. 262) define mathematics self-efficacy as 'a situational or problem-specific assessment of an individual's confidence in one's ability to successfully perform or accomplish a particular task or problem' and consider it a predictor of mathematics anxiety which Bekdemir (2010, p. 312) defines as an 'illogical feeling of panic, embarrassment, flurry, avoidance, failing and fear'. It was evident in Kirsten's final interview that these are both related to her reluctance to contribute to conversations about mathematics teaching because she only felt comfortable contributing to discussions on mathematics topics which she felt confident with. Furthermore, previous negative experiences as pupils have been found to have a direct influence on primary school teachers' mathematics professional development in both trainee primary school teachers (for example, Bekdemir 2010) and experienced primary school teachers (for example, Hodgen and Askew 2007). It is possible that this was the case here too, with Kirsten's negative experiences resulting in her self-efficacy and anxiety. The fact she was in a group with a secondary school mathematics teacher

potentially made her engagement with a mathematically focussed project even more difficult.

Kirsten's perception of her own mathematics ability resulted in her avoiding mathematical discussions with the secondary school teacher throughout the entire 12 months of the project. On the other hand, Wendy was confident in her ability and engaged in mathematical discussions with the secondary school teacher during the project; for example, recognising vocabulary that the secondary school teacher used in the secondary school which she would not use in the primary school.

Teacher types and characteristics

A final point for discussion of how the teachers themselves influenced the project is to consider the teachers' characteristics. This can be viewed in terms of Hoyle's (1980) restricted and extended professionals, and the teachers' career pathways. Wendy and Kirsten, regardless of their initial reasons for participation, both engaged with the project for a significant amount of time and could be described as broadly extended. They were involved in a professional development activity that had many aspects: cross-school; cross-phase; mathematics; use of ICT in teaching and learning; use of ICT to communicate; and teacher collaboration. Although neither pair engaged with all these aspects, the teachers did engage with the aspects that they felt were relevant to them. The main reason why Wendy's group participated was that it included a mathematics transition activity, and the main reason why Kirsten's group participated was their own career progression.

This research has shown that on the one hand a cross-phase and cross-school collaboration provides a great wealth of opportunities for teachers to develop and, on

the other, there needs to be an awareness of the influencing factors of professional development in these settings.

Implications for cross-school and cross-phase collaborations

While the recommendations from education bodies and governments are championing the use of collaboration as a form of professional development for teachers, we must be mindful of hindrances and how these might be overcome. The research into the professional development of Kirsten and Wendy revealed a number of influencing factors on the professional development of primary school teachers in a cross-phase and cross-school collaboration. As discussed previously, the prospects for professional development in these settings is wide and the opportunity for teachers to work with colleagues from other schools can expand the possibilities for experimentation, expand access to resources and provide opportunities to discuss subject knowledge in depth. When participating in such collaborations two area where schools and teachers should pay particular attention is school support and subject knowledge.

School support in cross-phase and cross-school collaborative CPD

The NCETM (2009a) identified cross-phase and cross-school collaborative CPD as an area for further investigation. The research presented in this article suggests that schools are more likely to support cross-phase and cross-school collaborations when the focus of the activity is beneficial for the school, not just for the teacher. Wendy's group focused on a transition activity for a group of primary school pupils. Although the teachers also taught year eight pupils, they did so as a means of trialling the lessons before teaching the lessons to the primary school pupils. Both schools supported the teachers, enabling them to take time away from their usual classes to participate, use secondary school classrooms for the primary school pupils' lessons and transport pupils

between schools using the secondary school's minibus. Conversely, Kirsten's pair did not focus on an activity that benefitted both schools, even though both teachers saw their participation as professional development for themselves.

Subject cross-phase collaborations involving primary school teachers

On one hand Wendy appeared to thrive on the opportunity to discuss mathematics with a secondary school teacher and commented positively on having this opportunity. On the other hand, Kirsten's perception of her own mathematics ability influenced her willingness to participate in the mathematical discussions with her secondary school teacher. During the project there were only two occasions when the mathematics topic under discussion was something that Kirsten did not teach; however, she did not feel confident enough to engage in a mathematical discussion with the secondary school teacher. She claimed that she would never be at ease discussing mathematics with a secondary school teacher because the secondary school teacher taught mathematics to a higher level than she taught mathematics. In Kirsten's final interview she considered that her avoidance of cross-phase collaboration was not related to the subject but stated that she would feel similarly about collaborating on a science topic, a subject she felt passionately about and for which she was school coordinator in addition to her role as mathematics coordinator. This view of avoiding collaboration with secondary school teachers is likely to be similar for a collaboration in any other subject for Kirsten, given her realisation that she preferred planning lessons by herself:

> *If there was an opportunity to team plan with anybody, ever, I wouldn't take it.*
> (Kirsten)

For these two teachers it was not clear from the beginning of the project that they would

have such different views on this topic and it is not clear from the data that either of them was aware of these views at that time. This highlights an issue with research in the field of professional development in England: just as we acknowledge that learners have different preferences, teachers engaging in professional development will have their own preferences. For a teacher to foresee that a new way of learning (collaborative) is a method which they will enjoy and want to engage with requires much self-awareness. Given that teachers in England have been educated in a system where teachers work alone it is understandable that, although agreeing to participate, the actual engagement in collaboration can be a step which is very difficult to take. As such, if cross-phase and cross-school collaborations in mathematics are to take place, then primary school teachers' potential willingness to engage with secondary school teachers and anxieties must be considered and addressed.

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[i] Kirsten and Wendy are pseudonyms.

ii The data for my doctoral study consisted of 10 lessons observations, 11 meetings, eight interviews, online communications, field notes, informal discussions and project documentation. Meetings and interviews were audio recorded and fully transcribed.

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