

Independent Study of Computing At School Master Teacher programme

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Summary

Computing At School (CAS) commissioned Sheffield Hallam University to undertake an external evaluation of aspects of its provision to:

- understand the impact of CAS Master Teachers on the knowledge and practice of CAS members.
- identify implications of this and of the current programme more generally for future evaluation activity.

A sample of 9 Master teachers and 15 CAS members were interviewed with participants sampled to reflect the diversity of these groups

The analysis of the interviews provide insight into the experience of rapid change in schools in England as schools meet the demands of the new computing curriculum. CAS is viewed very favourably by teachers with the following features particularly valued:

1. The speed of response to the rapid changes in the curriculum.
2. The approachability and commitment of Master Teachers.
3. The quality of professional development courses, particularly those aimed at those who are engaging with computing for the first time.
4. The combination of different types of expertise of Master Teachers .
5. The availability of resources on the website.
6. The flexibility of professional development including on-line training in programming.
7. Face to face meetings to network with other teachers through CAS Hub meetings which at best offer a varied and stimulating professional learning experience.

In addition, although less easy to define or assess, CAS activity appears to have had a significant influence on the development of a computing teacher identity, both for CAS members but also Master Teachers.

Case narratives of the nine Master Teachers were developed that indicate that predominantly teachers' motivations centre on supporting others.

Master Teachers develop their role to fit the needs of their local area. They can be seen as adaptive teacher leaders who enable the professional development of others and catalyse or support curriculum change. The role of the Master Teacher can be considered under the following categories: organiser, networker, broker, curriculum advisor, professional developer and computing champion.

Master Teachers identify a key impact as supporting others' confidence and subject knowledge. The following enablers to impact were identified: CAS organisational support; support from teachers' schools to undertake the Master Teacher role; the mixture of face to face and on-line support; the importance of peer relationships; the moral purpose and passion of Master Teachers. Barriers to

greater impact identified were: the policy and educational context; the limits of what CAS is able to offer; the challenge of marketing CAS; the title of Master Teacher.

CAS members engaged for diverse reasons that can be broadly grouped as: seeking personal and professional development; to support their role in developing others' computing skills and knowledge and developing the curriculum in their own schools; and in some cases to support them to engage in similar system leadership activities as CAS Master Teachers. Impacts members identified of Master Teacher support were: networking and facilitation of peer support and deepening of subject knowledge. Members identified a range of factors that were important to accessing support. Some of these were broadly the same as those identified by Master Teachers. Two particular themes stood out: firstly, the approachability and enthusiasm of Master Teachers; secondly, that the various aspects of CAS activity allowed for different ways for teachers to engage at different times and for different purposes. A number of barriers were identified by individuals to accessing support, however no clear pattern emerged in these.

The study identified the importance of considering aims for future evaluation focused on quality, impact, and mechanism/process modelled through a theory of change. Potentially CAS could learn from evaluations of relevant comparator programmes/organisations.

The following issues to consider were identified, grouped into categories of CAS organisation, the CAS offer, and future evaluation.

CAS organisation

1. Resourcing of Master Teachers and Hubs.
2. Reviewing the Master Teacher and other designations.
3. The nature of the relationship between Master Teacher and Hub Leader activity as well as other aspects of the Network of Excellence.
4. Marketing. CAS should seek additional resource/funding to promote its activity and develop greater recognition of what it does.

The CAS offer

5. The study indicates the value of face to face support. Further on-line support is indicated for specific training such as in programming languages. CAS should consider the extent to which the offer made locally should vary from place to place.
6. There is potential to support computing in primary schools through making clearer links to other subjects and particularly mathematics.

CAS as part of a self-improving system

7. CAS should consider how to strengthen its network with the Teaching School Alliance network both to promote its work but also because Teaching Schools are effective Lead Schools or hosts for Hubs
8. CAS should consider mapping patterns of engagement and identify 'cold spots' to target areas for development.

Future evaluation

9. Regardless of whether for future independent evaluation or otherwise, CAS should consider identifying the intended impacts on teachers, teacher networks, schools, and pupils of activity.
10. In planning future evaluation, CAS should consider lessons to be learnt from evaluation of comparator organisations
11. In seeking further funding, CAS should consider the extent to which independent evaluation is a priority and seek funding for this as appropriate.

Computing At School has swiftly developed a cadre of Master Teachers to support the development of computing in schools. This study indicates that Master Teachers and CAS more generally are well-regarded by teachers who have engaged with it. CAS is making a significant difference to the implementation of the new computing curriculum.

1. Background

Computing At School (CAS) was established in 2009 by members from schools, higher education and the computing industry¹. CAS emerged in response to concerns about the relative marginalisation of computing in schools and the consequent lack of take up of computing at A level and at Universities. The scope of computing includes programming (and computational thinking that supports this), an understanding of computer systems and networks, understanding of human computer interaction and knowledge of how computers work². CAS contributed to debates about the place of computing in the school curriculum. These debates led to significant policy changes with the introduction of a new computing curriculum at both Primary and Secondary phases from September 2014 and attendant changes to GCSEs.

Computing At School has continued to develop as a membership organisation supporting members and other teachers to develop the school computing curriculum. A significant aspect of CAS's work is enabling professional development of teachers to meet the challenges of recent curriculum changes.

The CAS approach to professional development involves support for different forms of professional learning: cascade, training, classroom enquiry, accreditation, and mentor/coaching. The emphasis is on teacher leadership of professional development within communities of practice/professional learning communities. CAS supports a Network of Excellence consisting of Hubs, Hub Leaders, Lead Schools and Master Teachers, linked with supporting stakeholders such as industry and Universities.

CAS Master Teachers are classroom based experts who have undergone specific training with CAS to undertake the role. CAS Master Teachers can be designated as Level 1, Level 2 or Level 3 depending on degree of experience and training. This study focused on Level 2 and Level 3 Master Teachers and their activity and impact within the context of CAS activity as whole. Master Teachers are either funded or unfunded. Where Master Teachers are funded, schools receive funds to release teachers to undertake professional development activities.

CAS has previously undertaken extensive evaluation activities of the April 2013-2015 programme.

This includes data collection from:

- instant feedback from training sessions with Master Teachers - online questionnaire (617 responses) and impact 10 weeks on - online questionnaire (50 responses)
- an annual survey about CAS impact of the whole network membership (1417 responses).
- an audit of 199 of 258 CAS Lead Schools in April 2014.

The study of Master Teacher activity and impact supplements the internal evaluation.

¹ Bradshaw, P. & Woodward, J. (2012). Computing At School: an emergent community of practice for a re-emergent subject. In International Conference on ICT in Education, 5-7 July 2012, Rhodes Greece.

² Peyton Jones, S. (2009). Computing at School: The state of the Nation: A report of the Computing at School Working Group for the UK Computing Research Committee.

2. The Study

2.1 Aims

Computing at School commissioned Sheffield Hallam University to undertake an external evaluation of aspects of its provision to:

- understand the impact of CAS Master Teachers on the knowledge and practice of CAS members
- identify implications of this and of the current programme more generally for future evaluation activity.

2.2 Methods

We undertook telephone interviews with 9 Master teachers on the impact of their practice and with 15 CAS members who had participated in training events and activities led by Master Teachers. An interview schedule was developed in consultation with CAS and piloted (see Annexe 1). Ethical approval for the study was obtained through institutional ethics processes and the research was conducted in line with British Educational Research Association guidelines with participants being sent an information sheet (Annexe 2) and consent being obtained verbally. Interviews and consent were digitally recorded.

2.3 Interview sampling

Details of intended sample and rationale are given in Annexe 3. In the event, achieving the sample in a short-time scale, particularly of participant/members, was challenging, especially for sub samples where numbers in the overall population was low. Further, there were a number of last minute withdrawals from interviews. However, the overall aim was achieved of ensuring a sample that reflects the diversity of characteristics of Master Teachers and CAS members.

Members³

CAS supplied data on n=151 CAS members who had indicated in a survey they were willing to be interviewed. Of these n=140 were identified as suitable for the study as contact details were available and they had indicated they had engaged with a Master Teacher. A total of 90 teachers were emailed (of whom 25 were sent a reminder email, these were in categories where the population in the sample was relatively low). In order to obtain a representative sample, attention was paid to whether the teacher was based in primary or secondary phases and to their overall view of the usefulness of Master teacher training from their response to the CAS survey. The table below gives details of the final sample. There is some response bias in that those secondary teachers who found the support only partly useful are somewhat underrepresented in the sample. In addition, as will be seen in Section 3.4, a number of members interviewed had similar characteristics as Master Teachers, for example leading CAS Hubs, or independent activities focused on enhancing computing and teaching of computer science.

³ For simplicity we use the term 'member' to refer to those study participants who were not Master Teachers. Master Teachers are also CAS members.

Table 2.3a Participant sample

Summary for sampling	View of master teacher training				
	Total	Not at all useful	Part useful	Useful	Very useful
Primary population	30	0	4	17	9
Sample	5	0	1	3	1
Secondary population	110	1	25	39	45
Sample	10	0	1	5	4
Population total	140	1	29	56	54
Sample total	16	0	2	8	5

Master Teachers

To obtain the Master Teacher sample, 66 Master Teachers were contacted with attention again paid to whether they were based in the primary or secondary phases. In addition, we considered whether they were funded and Level 2 or Level 3 Master Teachers (Level 1 teachers were excluded from the study).

CAS supplied a data base of 332 Master Teachers. Additional data was provided separately detailing withdrawn Master Teachers and this was used to confirm the Master Teacher database was up to date. Level 1 Master teachers (n=131) were excluded from the sample, on the advice of CAS, as they were still undergoing subject knowledge training. In addition, a further 10 were excluded as there was no data on funding status (of the 10 excluded from sampling due to no data on funding status, 7 were Level 3 teachers). This gave a population of 191 teachers eligible for interviewing.

To identify Master Teachers to invite to participate in interviews, variables considered were level and funding status. For the Level 2 teachers, we also considered if they were Primary or Secondary based.

The number of Master Teachers by level eligible to be invited were:

- Level 2: n=179 (94%)
- Level 3: n=11 (6%).

However, in the event only 1 Level 3 Master Teacher responded to requests for interview. Table 2.3b gives details of Level 2 Master Teachers and the sample. Given the overall number of interviews the sample is broadly proportional of the Master Teacher population as whole, although it is important to note that this does not necessarily mean the views of the interviewees are representative.

Table 2.3b characteristics of Level 2 Master teachers

	Frequency	Primary	Secondary
Funded (population)	120	61	58
Funded Sample	6	4	2
Unfunded	59	18	41
Unfunded sample	2	1	1

2.4 Conduct of the interviews

Potential participants were emailed and invited to be interviewed. An information sheet on the project was provided. Consent was obtained at the start of interviews, which were digitally recorded. Case notes were made shortly after the interview.

Master Teacher interviews ranged in length from 32 minutes to 52 with a mean length of 42 minutes.

Member interviews ranged in length from 24 minutes to 41 minutes with a mean of 32 minutes.

2.5 Data analysis

Following interviews, a case description was developed based on the interview recording. To analyse the data we considered each interview as a single case, and generated a narrative of engagement for each one. In addition, we undertook thematic analysis across cases related to interview questions. This was informed by previous research on teacher leadership of professional development⁴.

⁴ Boylan, M. (2013). Deepening system leadership: teachers leading from below. *Educational Management Administration and Leadership*. <http://ema.sagepub.com/content/early/2013/10/24/1741143213501314.full.pdf+html>

3. Findings

3.1 The experience of change in computing in English Schools

In section 1, we noted the significant changes in the computing curriculum in English schools with the introduction of a new curriculum in both primary and secondary phases. This has occurred at the same time as reduction in Local Authority support for school improvement as funding has moved to support a school led system principally through the Teaching School Alliance network. The interviews give insight into how this is being experienced in schools in England.

Change in schools is rapid as teachers respond to the challenge of the new curriculum. In some secondary schools, where computing was an important part of the old ICT offer, the new curriculum represents an evolution. However, in others teachers report a lack of subject knowledge and confidence. This is an important motivation to engage with Computing At School. In the primary sector the situation appears more uniform, with most, if not nearly all, teachers needing to develop their skills and knowledge at a rapid pace and schools adapting their curriculum. Interestingly, one of the interviewees suggested that there are a significant number of primary schools who have not yet engaged with the computing aspect of the new curriculum and so have not yet engaged with CAS.

Given the curriculum changes, it is unsurprising to find that CAS activity including that of Master Teachers is addressing professional development needs. Nevertheless the study does underline that CAS's work is worthwhile and important.

3.2 Overall view of the impact of Computing At School

The overall view of interview participants about Computing At School was very positive, as the following quotes illustrate:

Hope it continues and develops further. It is a really, really fantastic resource and has been the life blood of computing and long may it continue (Bill).

It is very important that funding continues, it would make my job twice as difficult if it was not there (Julie).

This supports the CAS survey data. Particular aspects that were valued were

1. The speed of response to the rapid changes in the curriculum

CAS has responded quickly and met urgent needs:

Without CAS I think we would have been really, really struggling. Everything they have done and produced. The resources and community has been absolutely unbelievable because I think for a lot of teachers who have been confident with ICT but not computing at least they've got something to fall back on (Ed).

2. The approachability and commitment of Master Teachers:

She [Master Teacher] is always approachable and willing to talk (Debbie)

I think they're brilliant in that they are giving up their time in what is already a pressurised job. (Lynne).

3. The quality of professional development courses, particularly those aimed at those who are engaging with computing for the first time:

They do what they say on the packet. By the end of the first one you will know what an algorithm is and on the next one you will know how to get started with SCRATCH and they did that (Debbie).

4. The combination of different types of expertise that Master Teachers have

Some Master Teachers are recognised as having a great deal of computing expertise (with one named by people in different parts of the country). Where Master Teachers did not have this, their knowledge of pedagogy and curriculum was recognised:

The MT's are not necessarily that expert. But they are very aware of the context in which they teach and what would be most useful within the primary curriculum...what needs to be delivered and how (Malik).

5. The availability of resources on the website

Think it's great. 'They definitely have great resources on it. Yeah I'm a big fan! (Omoye).

6. The flexibility of professional development including on-line training in programming.

As an example, a number of participants had identified a need or desire to learn the Python programming language. The way these did this varied - one undertook an on-line course, accessed via CAS, another attending a series of 12 twilight sessions led by a local Master Teacher, another attended a two day training course then continued to learn in their own time.

7. Face to face meetings to network with other teachers through CAS Hub meetings which at best offer a varied and stimulating professional learning experience as this description indicates:

I try to get there as often as I can. It's held at the local University. They are very supportive and run programming courses for us as well. There are thirty minutes to chat over tea and coffee at the start. I always think some of the connections you make and all the networking is really good'. Then they have an external speaker or someone from the university. Last session there was someone from the robotics department showing us some basic things in robotic and they set up a SCRATCH programme that ran a Raspberry Pi that controlled a robot to make a cup of tea. Another time we had a primary teacher showing what they'd been doing with their Y1/2 class. Attendance can vary from 20-40 (Lynne).

In addition, although less easy to define or assess, CAS activity appears to have had a significant influence on the development of a computing teacher identity, both for CAS members but also Master Teachers. This is indicated in the portraits of both in the sections below.

3.3 Master Teachers

3.3.1 Being a Master Teacher: trajectory and motivation

In this section we provide short narratives that describe the motivation and professional trajectories of the nine Master Teachers interviewed.

Alice⁵

Alice is an experienced teacher of 20 years promoted to Head of ICT 3 years ago. She works in a large 11-18 faith based school. She teaches mainly at KS4 and KS5 due to lack of appropriate staff. She trained as a Master Teacher in 2014 and is funded to lead a minimum of three professional development events per year. Her degree was in an IT related area and she has undertaken a variety of courses both with CAS and the Open University to develop her computing skills. She stated 'I'm not a natural at programming and I've had to work hard to develop my skills if I'm honest'. She became involved in CAS around 4 years ago accessing a course on teaching GCSE computing. Her motivation to become a Master Teacher was that she recognised that curriculum changes meant that there was a significant need to support others given her personal experience of the challenges of developing subject expertise. Initially her focus was on local feeder schools but more recently has extended her offer to other primary schools. The school was recently designated as a CAS lead school.

Bea

Bea is an experienced teacher and Head of Department for 10 years she works in a successful converter academy formed by the merger of two schools. The school covers the 4-18 age range, but Bea teaches only in KS4 and KS5. Her background was in science but she moved into computing some time ago and took a post graduate qualification in computing. She has been a Level 2 Master teacher for over 2 years and is now a regional coordinator. Her motivation to engage with CAS initially was to be part of a community and to become a Master Teacher because of her experience of supporting the professional development of others in her own school.

Claire

Claire is a primary Y6 teacher with 12 years' experience. She is the computing lead in her school. The school uses a scheme that is taught by all teachers and she is responsible for termly CPD to support other teachers to deliver this. She became a Master Teacher in autumn 2014. Her motivation to train was to access the additional training it offered for her own professional development and to support staff in her school. Now she is a Master Teacher her focus has extended to consider what is needed to support other schools.

Dan

Dan is a primary teacher working in an independent school. Previously an AST, he teaches computing as a specialist subject in his school. His involvement in CAS was initially through a nearby Hub as part of his AST role. Since becoming a Master teacher in February 2014, he has established a new hub and sees this as his main contribution.

Emma

Emma is a secondary teacher working in a large 11-18 converter academy. She teaches computing

⁵ Note that names are pseudonyms to preserve anonymity and some details of schools are omitted for the same reason.

as a specialist teacher and is hopeful of promotion to Head of Computing in the near future. Her initial teacher training was a two year ICT PGCE. She has since go on to take an Open University degree in computing which she has nearly completed as well as BCS computing course. Her motivation to train was for professional development to benefit her and her school. She stated: 'none of us had a computing degree' - both she and colleagues felt unprepared to teach the subject. 'People are scared of the programming. They just think I can't do it'. She has established both a primary and secondary CAS hub.

Frank

Frank has been teaching for 12 years. He teaches in 45 pupil entry denominational primary school. He works across classes rather than with a particular year and is responsible for computing. His initial teacher training was in science but he has a personal interest in computing stemming from doing a computing GCSE. He got involved in the local Hub and admired what the local Master Teacher did. In addition, he stated 'I've always enjoyed doing staff CPD...the dovetailing of doing CPD with computing...really appealed'. He expressed his desire to 'get more out of kids than people think is possible'. He has been a funded Master Teacher for 2 years.

Gaynor

Gaynor works part time in a school supporting individual children and teaching computing as well as supporting other teachers to teach computing in her role as ICT coordinator. Part of her motivation to get involved in CAS was to network with others. Her motivation to become a Master Teacher 2 years ago was to increase involvement in CAS, to benefit from peer to peer support from other Master Teachers and others, to access training and to help develop a local network of schools to support other people in the area. She has been a funded Master teacher for just under a year. She has been supported in taking on the role by another Master Teacher following the merger of two hubs.

Hugh

Hugh is Head of Computing at a large 11-18 school. His first degree was in computer science. He became involved in CAS by attending a course three years ago at which there was representative of CAS presenting. Subsequently, he signed up to use the online resources. He became a Level 2 funded teacher due to motivation to find other colleagues with similar backgrounds and see how they were applying them in a school context. He also wanted to share resources, expertise and time more efficiently.

Ian

Ian works in an independent school for pupils up to 8 years of age. He is Head of Computing and supports teachers to teach the subject. Previously, he taught A level computing in a different school and has a background in industry as a programmer before teaching. He came into contact with CAS, he believes 5 years ago, when we was given a leaflet at a moderation event. He felt that the Master Teacher role fitted with what they were already doing as a lead school running courses for others. So becoming a master teacher was an opportunity to get what they were doing 'properly recognised'.

3.3.2 Reasons for becoming a Master Teacher

Considering the above profiles of the Master Teachers and their reasons for becoming a Master Teacher, the interviewees can be grouped into two categories. Claire, Emma and Hugh became Master Teachers as means for personal professional development and in order to benefit their own

school. Alice, Bea, Dan, Frank and Gaynor refer to a desire to support others. However, although the degree of altruism varies, even if the initial starting point is more personal, or centred on their own school, then this appears to change once they become Master Teachers.

3.3.3 Master Teacher activity

Funded Master Teachers are asked to offer a minimum of three training events per year. As well as the formal role, Master Teachers also appear to develop their role to fit the needs of their local area. As such they can be seen as adaptive teacher leaders⁶ who enable the professional development of others and catalyse or support curriculum change and who broadly fit within the characterisation of teacher system leaders⁷. The role of the Master Teacher can be considered under the following categories.

- Champions - promoting computing and its importance.
- Organiser - organising meetings, events, workshops and hubs.
- Networker- creating and maintaining networks of teachers - this is done principally through hubs but networking is broader than this, and some connect with other networks.
- Broker - supporting colleagues to access support or to connect with networks.
- Curriculum advisor - offering advice on curriculum development.
- Professional developers - leading professional development activities.

The latter two roles are conducted in a two main ways: either in the context of group activities - for example in a training course or workshop - or on a one to one basis. The Master Teacher is fulfilling the role of a mentor/coach, when giving curriculum development advice or supporting professional development on a one to one basis. This may occur on a more formal basis - for example, when visiting a school - or on a more informal ad-hoc basis where a teacher may email or phone for advice or a Master Teacher responds to a tweet or posts to a discussion board.

The degree of activity reflects the length of time they are in role and the nature of their role. Unsurprisingly, a CAS Regional Coordinator was the most active Master Teacher interviewed and engaged in work beyond the expected 3 events per year, attending other events to act as a 'a champion for computing'. Although generally those who were new to the role were engaged in less activity, there were examples of new Master Teachers not only hosting training events but also speaking at conferences and engaging in rapidly building or strengthening networks. A number were running CAS Hubs and this was a significant part of their activity. One highlighted contributions to the website in terms of uploading resources.

3.3.3 Master Teacher views of their impact

The two main areas of impact described by Master Teachers was on teachers confidence and subject knowledge. As Bea puts it in response to being asked about impact:

I help teachers with subject knowledge and helping to ensure they understand the concepts prior to teaching them. I give people confidence to go away and actually use the resources. I give them the confidence to give it go (Bea)

⁶ Boylan, M. (under review) Enabling adaptive system leadership: Teachers leading professional development. *Education Management and Leadership*.

⁷ Boylan, M. (2013). Deepening system leadership: teachers leading from below. *Educational Management Administration and Leadership*. <http://ema.sagepub.com/content/early/2013/10/24/1741143213501314.full.pdf+html>

This was also referred to as 'reassurance':

It was reassuring for them. One of the teachers who came said 'you made me realise I know a lot more than I think I know' (Frank)

Another stated that recipients of support valued the opportunity to develop planning skills and consider a sequence of lessons. Master Teachers acted as a gateway to resources either through sharing at Hub meetings or advice about the website. Some members sought advice from Master Teachers on specific issues including how to prepare for a lesson observation. A common theme was the importance of creating opportunities for members to network.

Master Teachers found it more difficult to identify specific impacts on members' schools or pupils. This is not surprising given these would be indirect beneficiaries of their activity, although it does highlight the issue of the challenge of identifying this. However, one specifically pointed to training offered and a school beginning an A level computing course.

3.3.4 Enablers to impact

The Master Teacher interviews revealed there to be a number key enablers to eliciting an impact on CAS participants, such enablers are categorised below

CAS organisational support

In the main Master Teachers praised the organisational structure of CAS and welcomed the level of support received; this was received in a variety of guises including the training attended, CAS administrative assistance as well as input and encouragement from regional co-ordinators, fellow MTs and Hub networks.

Support from their school to undertake the Master Teacher role

The majority of respondents noted that their own school played a key role in permitting them to fulfil their Master Teacher role to the extent they did. In most instances school support amounted to little beyond honouring the planning time Master Teachers are entitled to and offering broad encouragement. However, support in other schools extended to hosting CAS events within the school, providing basic catering, sanctioning additional attendance at CAS events (e.g. conferences), and in rarer instances the provision of school administration time for arranging events/training courses run through the school. Greater school support tended to be available when the school was a Teaching School and/or where the school was a designated CAS Lead School. The financial support for funded Master Teachers was important to gaining school support. Although the sample was small it appears that there is a multiplying effect where CAS funding means Master Teachers can access additional support from the schools.

Face to face vs online

A number of the Master Teachers sought to endorse the potential contribution an online offer could /does make to CAS members. For example, online delivery could be a pragmatically good alternative if face to face interaction was not feasible; a useful way to sustain/enhance a network initiated through face to face contact and an option to keep costs down.

Nevertheless, all of the Master Teachers indicated that on balance face to face delivery was more favourably received by participants and many outlined a concern as to what would be lost if face to face contact was removed.

No it would just not be the same. Face to face is essential (Bea)

Central to the concerns was that the lack of face to face contact would somehow impede and stifle the relationship between Master Teacher and participant; set amidst a context where many teachers were said to already be feeling alienated might mean participants would feel less comfortable to ask questions and/or seek clarification.

Teachers can feel quite isolated dealing with the new curriculum and online reassurance can feel quite clinical (Claire)

A related apprehension was that the purely online delivery would adversely affect the creation of and future impact of networks between teachers:

I do think it's better face to face. Our hub meetings in particular are quite informal...it's about networking as well (Emma)

One Master Teacher broadly advocated the use of online training/support. However, they stated they had previously tried to run online training in the past but that nobody had engaged. Finally, one Master Teacher even questioned whether they would still want to be involved with CAS should they remove the face to face dimension of the offer.

I don't know how much involvement I would want if it was all online (Bea)

Peer focused

Master Teachers as teacher leaders hold a designation as experts, whilst at the same time they are in similar roles in their own schools to those that they support. Thus they can be considered both as a relative expert and also as a peer. Virtually all of the Master Teachers were at pains to distance themselves from the tag of *Master Teacher*; even though many stated they perceived that many of the participants did view them as being experts, at least initially.

Frank felt that the reason many teachers viewed them as experts were because they were 'desperate for help'. As such MTs appeared to be very sensitive to project themselves as peers as opposed to experts and to do all they could to reduce any power imbalance. Frank for instance typifies a down to earth (often self-deprecating) approach to building a relationship with CAS participants...

I sell myself as somebody who teaches these things in class and these are things that I found out...and I always include at least an anecdote of somewhere it's gone wrong...I don't want to come across as a know it all. I just want to help people. People are more receptive to people who are human (Frank)

A different Master Teacher emphasised the importance of pitching CAS activities in a peer orientated manner that recognises the participants as a capable and professional audience.

I think it's important when you are training adults that you treat them as peers because they are and their ability to learn is very different to that of a student (Alice).

Moral purpose/Passion

However, arguably the greatest enabler to participant impact was the dedication/enthusiasm of the MTs themselves. There was talk of a 'can do attitude' and in a most instances a genuine willingness to do whatever they could to assist CAS participants.

As a Master Teacher if someone asks you to do it you do it (Claire).

Anything I can do, I do (Emma).

Although the financial contribution was useful, the majority of Master Teachers appeared to spend considerably greater amounts of time beyond the official allotted time they received - as discussed above, this was driven by an altruistic desire to help fellow colleagues.

I have always had to find time to train staff at school and done a lot of CPD in school anyway. Thought it would be something I'd be able to help with as have lots of experience (Bea).

I've always enjoyed doing staff CPD...The dovetailing of doing CPD with computing...really appealed (Frank).

Personally, it's a commitment after school and 'you can't do everything; particularly when you have a family. My family are supportive but there's a lot of time spent at home working on your laptop. (Gaynor).

3.3.5 Barriers to greater impact.

The interviews with MTs drew out a number of barriers to maximising the impact that MTs could have on CAS participants directly and/or for CAS participants to further disseminate learning within their own schools. These are categorised into the following three broad categories, discussed in this section.

Policy and educational context

It was clear from the Master Teacher responses that the financial landscape across schools was one often characterised by very limited budgets (if any) earmarked for training generally, but particularly in relation to subjects like computing. This is combined by, what Master Teachers reported as, a lack of status of computing in comparison to core subjects such as English, mathematics and science. The focus of accountability measures such as performance tables meant that computing was often seen as a relatively low priority area. This is particularly the case within primary schools.

As such this meant it was almost inevitable that most CAS courses were run after school. This was seen to be difficult for many teachers and as such acted as a key barrier to maximising attendance.

There just seems to be an expectation from the government in the way they want teachers to learn about computing, you can do it in your own time. They won't give you curriculum time to do it because it's not a core subject. It's not that important...There is an expectation with the way CAS is doing things that you have to do it in your own time (Dan).

Within this context of competing priorities and stretched time, teachers (again particularly at primary) were often said to have a tendency to 'bury their head in the sand' when it comes to computing and it remained something to 'face next year' (Frank).

The limitation of what CAS is able to offer

When asked about other sources of CPD teachers or Master Teachers were accessing, it was clear that CAS were the most important source; as such it is perhaps not that surprising that meeting the needs of all members was challenging.

It is very difficult to cater for every single need of every school. I mean with the training sometimes I don't even know what they need training on (Emma).

As outlined earlier, the extent of the 'offer' provided by each Master Teacher varied considerably (see Section 3.3.1) with the focus varying on the basis of need in each locality but also to some extent the expertise of each Master Teacher and their familiarity with particular school phases.

For example, one Master Teacher stated that they took the decision to focus on building up a computing community by running sessions through a newly formed CAS hub and deliberately decided to not run formal training sessions because they felt without 'a critical mass of people' this was not warranted. They were currently in negotiations with CAS as to whether the running of these hub events could be counted as equivalent to the training sessions (that the funding was focused on).

In addition, there was a sense from one Primary Master Teacher that CAS did not fully appreciate the level that the typical primary school could engage with computing content.

I don't think CAS knows where primary schools are...they have an overinflated view of where primary schools are. For example when we give out the progression pathways which are supposed to help primary school teachers to assess it means nothing to them...For many you really need to go back to square one and just build it up from nothing. I've never been in a situation where I've been doing training and thought I'd pitched that too low (Frank).

In a separate example, a Master Teacher from the independent sector revealed they nearly stopped becoming a Master Teacher because they were being forced to charge for courses despite previously having secured sponsorship from a private company to subsidise the costs for each delegate.

The comprehensiveness of the CAS offer was often dependent upon the goodwill, available additional time and willingness to go above and beyond the core requirements of being a Master Teacher and/or Hub Leader.

You run your own ship really. You are your biggest barrier (Dan).

Personally, it's a commitment after school and 'you can't do everything; particularly when you have a family. Family are supportive but there's a lot of time spent at home working on your laptop (Gaynor).

Marketing CAS

It appears that Master Teachers particularly struggled with the marketing aspect of their role. Administration and marketing was said to take a disproportionate amount of the Master Teachers' time and therefore was a barrier to supporting teachers.

Better marketing and awareness among schools would free us up to focus on our role to make more of an impact (Frank).

In a number of instances Master Teachers articulated how they would like CAS to provide more clarity/help on who to invite to meetings and to provide greater assistance with compiling lists of contacts or mailing list to improve communication externally.

Found it difficult marketing myself to schools (Frank).

Am I a marketing manager? Probably not. There needs to be a better way to get the message out (Alice).

Sadly I don't think CAS have been very good in promoting things (Dan)

According to at least one Master Teacher some of the marketing issues stemmed from the lack of national awareness of what the Master Teacher role entailed.

I don't think it's very clear at all what Master Teachers' are for outside of the organisation (Dan).

The title of Master Teacher

Above we discussed issues of the peer/expert boundary that Master Teachers straddle. For some Master Teachers the title of 'Master' teacher was said to be itself problematic and unnecessarily muddled what the remit of the Master Teacher was. On a number of occasions Master Teachers reported dedicating time when introducing themselves to CAS members in order to distance themselves from such a title and clarifying what they themselves took their role to be. This issue appears to be of greater concern for primary Master Teachers.

I laugh at that all the time (Alice)

I think by your title they feel a bit intimidated (Claire)

The role involves sharing ideas - giving people information to share with each other. But we are not the masters of everything (Gaynor)

3.4 CAS MEMBERS

3.4.1 Diversity of participants and motivation for engaging

In this section, we provide brief descriptions of the 15 interviewees. We group these into the following categories with attendant motivations and/or informal roles: personal professional development orientation; school based computing developers; system leaders.

Personal professional development orientation

These interviewees were primarily concerned with their own professional development. In some cases, they did have responsibility for computing in their school as part of their school role. However, they appeared to engage with CAS in order to develop their own understanding and skills. In the case of Kate, for example, although the ICT lead in her schools, was a single person department and so developing others was not a motivation.

Fran

Fran is a highly experienced teacher (21 years) who currently teaches computing (formerly ICT), English and games at a 4-18 Independent school. She is also a house mistress. Fran did a teaching qualification in English that covered ICT and in 1992 did a Masters in Computer Science but due to the changes in the curriculum '*felt at the bottom of my learning curve*'. In 2013 she met a local Master Teacher by attending a hub meeting at their local University. She stated that from then on it has been '*full steam ahead*'. Fran has attended 5 Hub meetings (including ones outside of the immediate locality), a training session on assessment, engaged fully with the website/forums and will be attending and presenting at the forthcoming CAS conference.

Henry

Henry is a Teacher of ICT and e-learning co-ordinator at a medium sized 11-16 secondary that currently requires improvement. His original degree in was in Sports Studies and Information

Systems so has some background in programming and ICT. Henry has been teaching ICT at the school for 12 years but only recently informed of the requirement to teach Computer Science. This shift prompted them to seek support and they 'ended up hitting on this link for CAS'. So far Henry has attended a 2 day training course, about OCR computing led by the Master Teacher but their main involvement has been via CAS hub meetings where they have done 'quite a lot of work on Python and Raspberry Pi's'.

Julie

Julie is a Year 1 teacher and ICT co-ordinator based at a small one form entry primary located in an urban area. Julie has 19 years teaching experience but has only held the ICT co-ordinator role for 18 months. It was this new role that motivated Julie to seek out CAS support. This support was initially accessed through following an electronic link and accessing online forums. Subsequently Julie's involvement with CAS has expanded to include an on-line scratch programming 5 week course delivered via a University and an assessing computing course led by a Master Teacher.

Kate

Teaches computing and ICT across two separate, large, single sex 11-18 grammar schools. She has taught at the girls' grammar for over 25 years and the boys only from last year. Kate trained as a Design Technology (DT) teacher but her teaching of ICT grew to the extent she no longer teaches DT. She undertook a HNC in computing 15 years ago. Kate was originally alerted to the existence of CAS and the training they could offer through attending sessions put on by various exam boards, following the shift in the curriculum towards computing. Kate's motivation for accessing CAS support was largely opportunistic, in that the training was run locally and she was unsure what programming language to teach, so thought '*I've got to use one language and here is some free training so I'll go and do that one* on Java'. Kate's involvement with CAS centred primarily around the Java training courses - where she completed the beginners, intermediate and advanced versions. In addition, she also makes use of the website and forums, engaging in discussions and sharing resources.

Lynne

Lynne is Head of ICT and Computing at a medium sized but rapidly rising, all through school (3 months - 16) with an intake 'skewed towards the low end of ability'. Her engagement with CAS began around 3.5 years ago while at a different school, when her then Head of ICT identified CAS as a useful resource when the school was adopting the new syllabus for GCSE computing. At that stage, CAS activity was limited to the exchange of resources via the online forum because the nearest CAS Hub was too far away. Lynne's relationship with CAS has intensified due to the creation of a new more local CAS Hub, which affords far greater networking opportunities and is something she regularly attends.

School based computing developers

This was the largest group of participants. They were teachers with responsibility for computing in their school. They accessed support from CAS and then used this to inform professional development of colleagues and develop the computing curriculum

Isobel

Isobel is a very experienced Head of ICT at a medium-sized secondary girls' Technology College with a very high percentage of the pupils with EAL and entitled to free school meals. Isobel was originally primary qualified teacher but did a conversion course in computer studies. She first made contact with CAS through attending a CAS Hub. She was motivated to become a CAS member primarily due

to the void left in the withdrawal of support previously offered by the Local Authority. CAS membership was appealing due to the prospect of accessing resources and connecting with 'like-minded' people. Isobel has attended CAS hub meetings, Master Teacher run meetings and made use of resources and online forums.

Bill

Bill is Head of IT, Computing and Business within a medium sized mixed 11-16 comprehensive school. He has a computing based degree background but 'needed to develop skills to teach app development and also Python'. He first became involved with CAS around 3-4 years through attending the 'fantastic' CAS meetings run via the CAS Hubs, having been keen to tap into a network of 'like-minded teachers and to share resources and ideas'. Aside from attending CAS hub meetings, Bill has also made use of tailored Master Teacher support delivered through of Head of Department meetings and has attended specific training sessions on Python and Raspberry Pi.

Carol

Carol is a very experienced teacher that has worked at the same large, socio-economically deprived inner city junior school for 21 years. Her role within the school is split between that of an Y3 class teacher and responsibility for developing and delivering the new computing programme across the school. She has no formal computing training but having just completed an MA in Education Practice and Innovation -'started to really take notice of the changes in the computing curriculum'. Involvement in the MA was the catalyst for taking up CAS support which was signposted by a lecturer, whilst the affordability of the training made it possible. Carol has attended CAS hub meetings and received specific training from a Master Teacher on Scratch and Logo.

Debbie

Debbie works as an Early Years and Science co-ordinator at a small rural primary school and teaches a mixed age class (Reception, Y1 and Y2). Although she has no formal responsibility for computing within the school, Debbie proactively sought the support of a larger primary school with a stronger IT curriculum and is currently running an after school club 'to build up my own confidence'. Debbie has no qualifications in computing but is undertaking the OCR MOOC qualification for computing. Debbie has attended two CAS training sessions on algorithms and Scratch. She stated: - 'They do what they say on the packet. By the end of the first one you will know what an algorithm and on the next one you will know how to get started with Scratch '.

Ed

Ed is the Head of faculty for Computing and Business at an under-subscribed, medium sized, 11-16, recent academy convertor secondary school. He has received no formal computing training but developed skills and knowledge through a 'hobbyist perspective' and technician role at his school, which provided support for him undertake the GTP route into teaching. Involvement with CAS began around 3 years ago due to the need to develop practice in response to the new computer science curriculum. Involvement with CAS was facilitated because the CAS Hub was hosted at the University where Ed had undertaken his GTP. Ed has attended a number of termly run Hub meetings with optional sessions such as Minecraft, Raspberry Pi, Python and GCSE computing; as well as undertaking a full day training event on Python. He has also made use of resources the Master Teacher made available on a Google drive.

Omoye

Omoye is a Y3 teacher and ICT Co-ordinator at a large, mixed intake inner city, primary school. Omoye is relatively new to teaching (3 years) and has been in her current role for under a year. She

was made aware of CAS through an ICT co-ordinator meeting and was motivated to seek them out on the understanding that they were up to date with resources/advice on technology. Omoye attended a training session run by a Master Teacher based around integrating Scratch into the computing curriculum and its potential for cross-curricular work. CAS also signposted her to whole school CodePro training run through Barefoot. Omoye also visited the Master Teacher's school to have a 1:1 session and look at his lesson plans.

Gayle

Gayle is the curriculum lead for computer science and ICT at a large, rurally located, recently academy converted 11-18 secondary with sixth form. Gayle graduated with a computing degree 10 years ago but had been teaching ICT for 6 years and so was concerned about how the school could teach the new curriculum. Since joining CAS, she has regularly attended CAS hub meetings, made use of the forum/website for resources and undertaken Python training.

System leaders

The category of system leaders refers to those who like CAS Master Teachers support the development of computing beyond their own school.

Natalie

Natalie is Head of Computing and Director of ICT at a large, heavily oversubscribed secondary academy with sixth form. The school is also a CAS Lead school. In addition to teaching across KS 4-5, Natalie is responsible for looking at how technology is used for teaching and learning across the school and has worked very closely with feeder primaries to jointly plan their schemes of work and is now offering CPD to primaries. Her original degree was in Information Systems and she did a PGCE (IT) but feels had the background knowledge to teach computer science. She Joined CAS as an NQT. Her school had already predicted the shift in the curriculum towards computer science but was keen to help facilitate networking opportunities. Natalie previously undertook the Python summer school run over a period of twilights by a Master Teacher. There is no longer a local CAS hub 'but it's almost been replaced by just knowing people. Just to network'. Natalie states she is 'contributing more than receiving these days' - regularly making schemes of work available on forums etc. We have characterised Natalie as a system leader due to the work she does in other schools but it is notable that there was a Master Teacher also resident in their school.

Amanda

Amanda is Year 5 teacher and computing lead at a large primary school with a very high EAL percentage located in an area of high socio-economic disadvantage. Amanda has a Science undergraduate degree and then did an IT based PGCE. Her association with CAS is relatively new. She became formally involved a year ago through the recommendation of the school data manager who acted as a CAS champion for the school to become a CAS hub. Consequently, she is heavily involved with CAS acting as Hub lead and is currently undertaking Master Teacher training. Amanda has also attended formal training run by CAS on Scratch and attended Barefoot training.

Malik

Malik is a computer science teacher at large, high achieving secondary school with a sixth form. He has an additional role of city wide lead professional to help local primary schools teach computer science. Malik had a degree in Computer Science before undertaking a PGCE in IT. He was originally motivated to engage with CAS around 3 years ago at his previous school because of curriculum changes and they were one of the original GCSE pilot schools. Since moving to his current school via his lead professional role Malik was asked to deliver computing training to local primary schools.

His school now hosts a new CAS hub even though he is not designated as a Master Teacher. However, having primary Master Teacher support (not being a primary expert himself) is 'definitely an advantage' in that 'they are very aware of the context in which they teach'.

3.4.2 Impact of support

Networking and peer support

The most frequently mentioned and valued impact of engaging with CAS support was the opportunities afforded for networking with other teachers.

The community thing really drives it for me (Gayle)

Even though most CAS Hub meetings happened after school, participants were grateful to have some dedicated space/time to engage with 'like-minded' teachers to exchange ideas.

Allowing time for people to talk to others, that is what is rated most highly (Amanda).

There were various benefits of networking. For example, one participant met a teacher at the assessment session who had created a scheme of work and sent them an electronic copy. They further developed it together and they are now both using the same materials for Year Seven students. Many participants voiced how reassuring it was to realise that there were other teachers in a similar position, given the context of rapid and wholesale changes to the curriculum:

With me having such limited knowledge at the start it was very helpful to sit down and realise there was a lot of people in very similar positions to me (Henry)

Deepening of subject knowledge

Specific training courses afforded participants opportunities to deepen their knowledge around particular areas/technology such as Python, Java and Scratch

I think everyone felt their understanding of computing had moved on from attending (Debbie)

Heightened confidence and subject knowledge had additional benefits in that individual teachers felt more able to pass this on to their fellow teachers back at their own schools.

I feel I have become more proficient in Computing particularly in regards to the new curriculum and also passing on that to my fellow teachers has been a really good thing (Omoye)

Some had benefits in terms of career development of taking on leadership responsibility. Carol stated that without initial CAS training she would not have been able to have taken on her current role teaching computing across the school.

It's given me the confidence to start thinking for my myself about how I deliver things in the classroom (Carol)

Participants, in the main, referred to benefits in term of their own and others' professional development. Others, such as Bill made clear that through CAS involvement, pupils had a richer computing experience with more programming languages available to them.

3.4.3 Factors that enable accessing support

Members identified a range of factors that were important to accessing support. Some of these were broadly the same as those identified by Master Teachers. Two particular themes stood out. Firstly, the approachability and enthusiasm of Master Teachers. Secondly, that the various aspects of CAS activity allowed for different ways for teachers to engage at different times and for different purposes.

3.4.4 Barriers to accessing or making use of CAS Master teacher support

Teachers identified a number of ways that the CAS offer could be improved. What is notable is that there was no clear pattern between them. It should also be noted that 5 of the interviewees did not offer any suggestions, presumably this means they were satisfied with the current offer.

The remaining 10 suggested or commented that:

- the discussion boards were cumbersome and not easy to participate in - they preferred to use Twitter
- there was a lack of CPD in their area on underlying ideas about computational thinking
- that for some training they needed to travel relatively long way as it was not available in their area
- sessions on assessment
- a training on Python focused on assessment for a particular exam board
- the lack of time to get involved
- advice on equipment purchases
- Master Teachers having more capacity
- sessions on coursework
- sessions to support teachers not interested in computing.

It appears from this list that the diversity of what is offered in particular localities may not meet the needs of all teachers in the area.

Although not a main focus of the study, teachers also identified barriers to developing computing in their school which in turn impacted on engagement in CAS. The most common barrier teachers identified was time both to engage with CAS including on line materials and, for those who were computing school leaders, lack of time to work with colleagues. The issue of time was also raised in relation to computing in curriculum, particularly in primary schools with the focus on English and mathematics.

Others reported issues with equipment include school networks and incompatibility of equipment with new software such as Python. With regard to equipment, decisions were made to purchase tablet computers in order to allow use of educational applications but the need of computing was not necessarily understood or considered by senior leaders. The issue of lack of understanding of school leaders was also raised in relation to the challenge being faced with the new curriculum. One teacher had a head of department who they said was an ICT teacher and was 'out of their depth' and 'putting on a brave face'.

Others identified colleague's lack of knowledge and confidence:

The other teachers are not willing to take that leap of faith'. They need to get beyond making mistakes that's the whole fun of it, telling the children that you are learning with

them. You will make mistakes with them but that it doesn't matter. The children get that very easily but the staff don't. Staff are used to doing the digital literacy dimension i.e. typing and PowerPoint but it is the computer science that they struggle with (Debbie). .

4. Discussion and implications

4.1 Resourcing Master Teachers and Hubs

Computing At School have rapidly developed a network of Master Teachers, Hubs and Lead Schools. It has been able to do this by drawing on the enthusiasm of members in a context of relatively low levels of resource. It has provided enabling leadership⁸ that has supported both teachers who already had expertise and increasingly new experts to support colleagues to meet the challenge of the new curriculum. For CAS to have greater impact a key issue is securing more resource to enable its network to grow and for activity to increase. Clearly, CAS will already be aware of this need. Above we pointed to specific issues such as marketing and support with administration that Master Teachers identify as needed to enhance their work.

4.2 The Master Teacher designation

The interviewees have somewhat conflicting messages about the Master Teachers. Some of the CAS Master Teachers are seen as experts. However, other Master Teachers, particularly those less experienced in teaching computing, are uncomfortable with the title. For some of the Master Teachers the first motivation to become a Master Teacher was to access the professional development it offered for them personally. The rapid growth of the Master Teacher network helps to increase overall activity and impact, but it can also mean that some Master Teachers may lack depth of computing expertise.

One of the member interviewees, Malik, who has a profile of expertise similar or indeed beyond that of some of the Master Teacher interviewees has an interesting perspective. He contends that many Master Teachers are not necessarily experts in computing. He states that more needs to be done to ensure Master Teachers are put into contact with subject experts.

From what I have seen they[CAS] have taken on some people who don't have the subject knowledge of Computing Science...what I think is still essential is for the Master Teachers to be put in contact with the subject experts...so what needs to be delivered and the knowledge of the subject is combined together (Malik)

In some areas at least, this appears to be already happening. In Section 3.2, above, we described a Hub that meets at a local university and has sessions that are regularly led by University computing experts.

It is notable that although Master Teachers' primary contractual role with CAS is to provide training, they described their role in broader terms. The balance between being a peer and being an expert is clearly a complex one. It may be that this should be directly addressed in Master Teacher training, if it is not already considered.

More tentatively, it may be that the designation of Master Teacher may be a barrier to some of those we have identified as school computer leaders to undertake training with CAS.

⁸ Boylan, M (under review) Enabling adaptive system leadership: Teachers leading professional development. *Education Management, Administration and Leadership*.

4.3 The relationship between being a Master Teacher, Hub leadership and delivery of training

From both Master Teacher interviews and member interviews, it appears that the most important and valued activity by both groups were the CAS Hubs. Many of the Master Teachers were also Hub Leaders. It appears that leading a Hub is more time consuming than the organisation of training. At present Hub Leads can claim expenses for Hub sessions, for refreshments and travel expenses for speakers. There is no funding for the actual organisation of the Hub itself. An issue to consider is whether the time for running a Hub should be resourced in some way. In any case it appears that the relationship between Master Teachers and Hubs needs clarifying.

Above we identified six aspects of the current Master Teacher roles. In practice not all Master Teachers fulfil all of these roles. One approach would be to more clearly identify a designation of 'computing champion' or 'CAS lead who would undertake the following roles: organiser, networker, broker and champion. Such CAS leads might also offer curriculum advice or support the professional development of others, but this would be clearly on the basis of being more experienced peers. CAS training for such leads would focus on undertaking these roles.

It appears that there is still a role for expert curriculum advisors and professional development leaders or trainers, particularly at a regional and national level. One way to address this might be to consider a similar approach to the NCETM CPD standard. Under this scheme, those delivering mathematics CPD can accredit the quality of their work with the NCETM

4.4 Face to face or on-line support

Both groups of interviewees valued face to face contact. However, it is important to note that in responding to this question, participants were not necessarily only considering Master Teacher training. As stated above for many members the Master Teacher represented the Hub as much as any specific training event. Given the nature of the Hub networking meetings it is unsurprising that physical meetings were valued. Participants were more positive about on-line training that focused on specific skills and in particular on learning programming languages.

4.5 Relationship of CAS to other networks

A number of interviewees referred to other networks that related to computing and to the relationship of Master teacher to other experts. These issues point to the question of the relationship between CAS and the wider infrastructure of the school led system and in particular specialist leaders in education with a computing expertise as well as the Teaching School Alliance network.

One particular issue raised by Master Teachers was that of marketing. Further, considering the way in which members first become engaged indicates the importance of the promotion of CAS through networks and other organisations, such as exam boards. The developing network of Teaching Schools appears an important route for CAS to increase knowledge of its offer both through national communication and also by reviewing advice documents to Hub Leaders, Master Teachers and Lead Schools on the importance of using Teaching Schools as a route to advertise and promote activity.

4.6 Promoting a space for computing in the primary curriculum

The inclusion of Computer Science as a subject that contributes to the EBacc measure means that it potentially has a relatively high status within secondary schools. In primary schools the situation is different where considerable focus is put on mathematics and English/literacy. A number of interviewees discussed how they addressed this through developing both specialist computing teaching/lessons and through cross curricular work. This appears to be an area for development for CAS. Exploring the links with the new primary mathematics curriculum may be a useful given connections between the development of conceptual understanding of some mathematical concepts and the development of computational thinking. There is a potentially rich tradition to draw on here, Given the close links between mathematics education and computing during the first phase of development of computer science in education in the 1980's and early 1990s.

4.7 A diverse offering

CAS originated as a grassroots membership organisation. Its development of a Network of Excellence is based on teachers initiating activity and teacher leadership. One positive feature of this is the development of a cadre of computing enthusiasts. Intrinsic to a network approach and teacher leadership is that there is diversity. The advantage of this is that adapts to meet local needs. However, the disadvantage is that the CAS offer is heterogeneous, varying in different locations. In addition this variation is amplified because Master Teachers often go beyond what is expected of them. Although not a specific focus of this study, this also appears true of Hubs - both those led by Master Teachers and others. To address this, CAS might consider identifying a core offer of training and workshops hosted by local and regional networks. This might lead to the most judicious use of the most expert of CAS Master Teachers as well as other experts.

There is a risk that moving to a less diverse offer may undermine local autonomy and the energy that comes with a do-it-yourself, bottom up approach to professional development. However, the nature of the Hub networks themselves suggest that this will continue to be a feature of CAS activity.

4.8 Taking stock

Interview participants identified varying levels of engagement. At some point CAS may wish to take stock of the current level of reach and identify the extent to which schools have become part of the CAS network, patterns of engagement and identify - 'cold spots' where there is little CAS activity. Further study may be worthwhile to understand barriers to engagement by those who have not yet engaged.

5. Future evaluation

This section considers possibilities for future evaluation of Master Teacher impact as part of the CAS programme. The impact of Master Teacher activity cannot be easily isolated from other CAS activity. Master Teachers are part of the CAS Network of Excellence which in turn is embedded in a wider ecology of CAS initiatives. Important too, is the articulation of CAS activity with other support for computing as well, we have argued, the new landscape of the self-improving system. Below, we present a linear logic model as a theory of change to inform future evaluation as well as pointing to the limitation of such models and the potential of an approach informed by systems thinking. We then discuss lessons from evaluation of potential comparator/programmes; summarise practical issues that arose in the current study.

5.1 Aims of evaluation

There are a number of ways of organising any evaluation. We suggest that the nature of Master Teacher activity suggests using a categorisation drawing from Realist Evaluation⁹ which utilises three broad categories for consideration aims of evaluation: quality, impact and mechanism. In addition, whatever the focus of the evaluation it is important to understand context.

Quality

Evaluating quality can inform improvements. It also addresses issue of fidelity of implementation - is activity happening as intended. CAS already used a wide range of tools for assessing the quality of its activities, including: feedback from Master Teacher training sessions; post-reflections on CPD as well as an annual survey of members. The current study will also produce data related to quality.

Impact

The aim here is to prove that the intervention is worthwhile. Identifying impact is, in many ways, more challenging than evidencing quality. This is particularly true when a programme has the following features, which are arguably characteristics of CAS:

- effects are dispersed and distributed and so not necessarily easily traced back to CAS activity (for example a teacher attends a Master Teacher event, and then passes on an idea or activity to another teacher in a different school)
- actors are entangled - different aspects of CAS activity are entangled with each other and are mutually supportive, in addition CAS activity is entangled with other support and drivers for change in relation to computing in schools
- effects are entangled - interconnected and complexity models of professional learning indicate multiple pathways through which professional learning and teacher change can occur; impacts on teachers, impacts on learners and impacts on schools are multiple and interwoven
- some effects may be long term - for example CAS activity in Primary schools will take a long time to be evidenced in increase in Computing GCSE entries.

The above features point to the need to clearly identify both final and intermediary impact measures. Final impact measures for Secondary might be an increase in GCSE computing of schools

⁹ Pawson, R. and Tilley, N (1997) Realistic Evaluation. London: Sage.

in which CAS members teach. Intermediate measures might be the development of local networks and increasing teacher to teacher connectivity.

Mechanism/process

Evaluation activities focused on the mechanism or process seek to understand why the quality of the programme is found to be as it is and how and why it has the impacts it has. Understanding the mechanism and process that leads to outcomes can support refining the programme. Understanding process requires the use of appropriate theoretical tools and application of existing knowledge.

5.2 Developing a theory of change

In evaluating professional development and other interventions starting questions will be

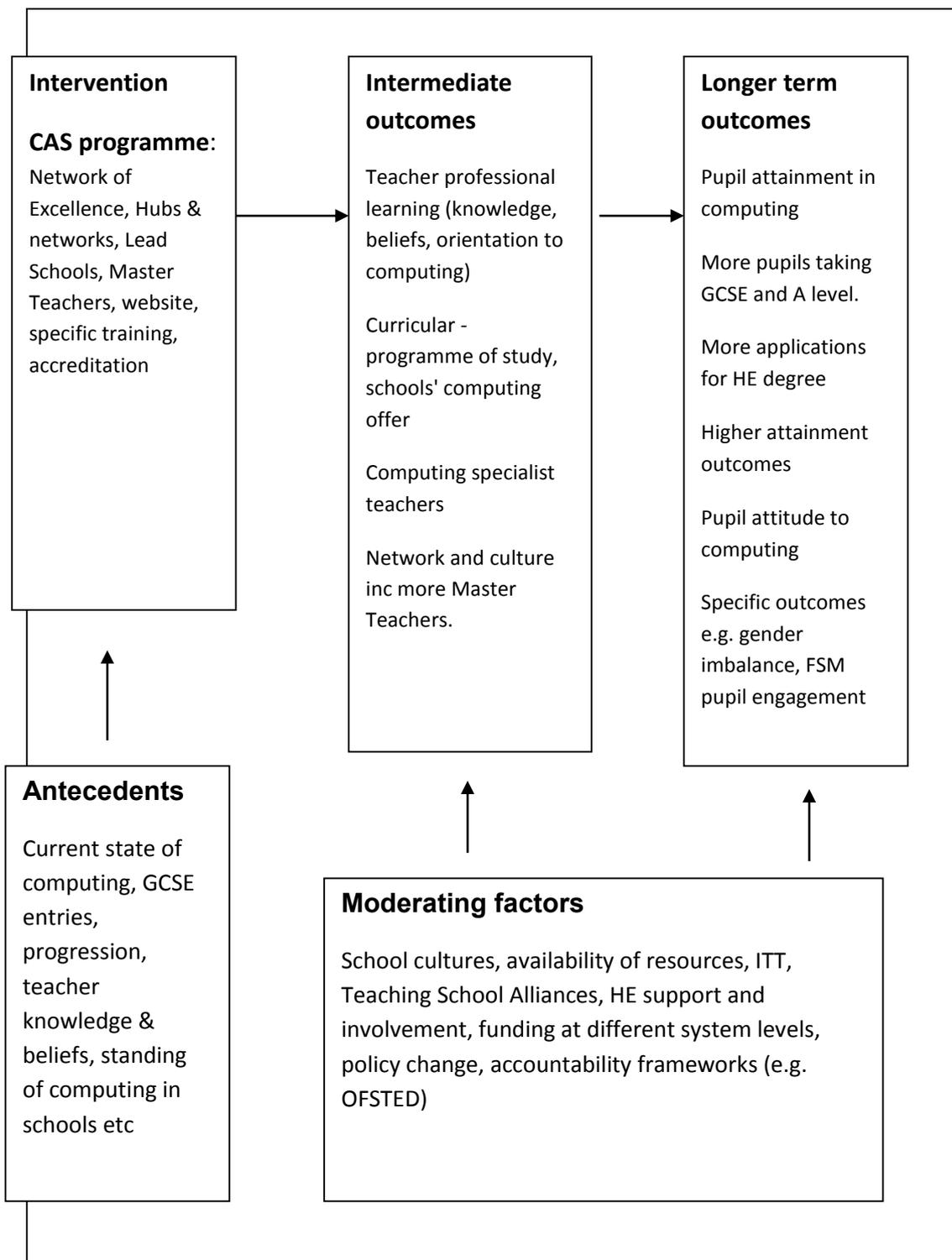
- what outcome(s) have occurred? (intermediate and longer term outcomes)
- why did they occur? (how does the intervention work to lead to these outcomes?)
- for whom? (which pupils, teachers etc. will see these outcomes? will they differ for different groups?)
- in what contexts? (what are the factors that might get in the way of positive outcomes - or might make these outcomes more likely to occur?)

Common problems at this point are focussing on too many outcomes; focussing in too much detail; focussing on too many different stakeholder outcomes; and conversely not having enough detail.

The diagram below describes the first step in developing a theory of change through a logic model for CAS¹⁰. It is a generic model that could be adapted to focus on specific aspects of the CAS programme such as the Hub programme. The same structure can also be used to consider a particular case study for example focusing on a specific school.

Key to developing this model further would be to populate the categories with more detail. The model can then be used to inform data collection in the evaluation. In particular the model directs attention to intermediate outcomes and the relationship between these and the longer term outcomes.

¹⁰ For more discussion of the application of logic models see Coldwell, M. and Simkins, T (2010) Level models of continuing professional development evaluation: a grounded review and critique. *Professional Development in Education* 37 (1). This approach informed the current study reported here.



In relation to our suggested three aims, using this kind of logic model, the evaluation would be paying attention to the **quality** of the intervention; how it works (**mechanism**), to lead to what outcomes (**impact**) in what circumstances and for whom taking account of moderating factors and antecedents (linked to **context**).

Linear logic models, such as initial version above, necessarily simplify the complexity of change and the interrelationship of different factors. More complex models may include feedback loops. For example, key to the CAS approach is the development of networks through Hubs. The size and connectivity of hubs might also be characterised as intermediate outcome - something that CAS aims to foster. Similarly, an outcome might be to increase the number of Master Teachers which in turn supports more teachers to access professional development, leads to more Hubs, which in turn can support the recruitment/development of more Master Teachers. The current study of impact does indicate that one of the strengths of CAS is the amplification of its intervention in this way.

The CAS programme can be characterised as an ecological approach to professional development¹¹. One feature of this is that different aspects of the programme are mutually influencing. In itself understanding how different parts of the programme interrelate in order to lead to intermediate outcomes is itself, potentially an important focus for intervention.

One consequence of considering a logic model approach is that it emphasises the need to be clear about what outcomes are being evaluated. Arguably, what should be mainly attended is the extent, reach and nature of CAS activity and its impact on the intermediate outcomes. To develop the model to fit the specific programme, it would be important to test out the initial model (above) with CAS and others at an early stage to refine it to fit as closely as possible the aims and intended 'route to impact' for the Master Teacher programme. Important too is to draw on what is already known about teacher professional development and change innovations.

5.3 Learning from the evaluation of comparator programmes/organisations

In developing its approach to evaluation CAS can potentially learn from other similar initiatives and/or define its approach in contrast to that of others.

Two UK organisations in the STEM area are of potential relevance having some features that are similar to CAS: The National Centre for Excellence in the Teaching of Mathematics and the Further Mathematics Support Programme.

The National Centre for Excellence in the Teaching of Mathematics (NCETM)

Established in 2006, the NCETM has moved from providing or instigating professional development to a focus on supporting leaders of professional development. Currently, a central aspect of its work is supporting the Maths Hub network. Its work in its first phase had some similarities to CAS involving support for teacher led professional development supported by a network of regional coordinators, ambassadors, associates and ASTs (which has some commonalities with the Master Teacher network). Similarly to CAS, the activity of the NCETM is focused on enabling others to lead

¹¹ Boylan, M., Coldwell, M., and Simkins, T., 2011. Complexity and leadership in teacher professional development: the case of the National Centre for Excellence in the Teaching of Mathematics. Paper presented at the British Educational Research Association Conference, 6–8 September, 2011, London. Available at <http://www.leeds.ac.uk/educol/documents/221007.pdf> (accessed 1st October 2013).

or instigate professional development. This means that as well as direct beneficiaries of activity there will be indirect beneficiaries of activity. As discussed above, many of those who have accessed Master Teacher support then in turn support colleagues in their own schools. Professional learning ripples or diffuses to other teachers and schools. This is likely to take place over a period of time.

Experience of evaluation of the NCETM has shown that this is very difficult to monitor or to collect data on impact on indirect beneficiaries at least on a national scale using survey-type methods. This is because typically the knowledge of who these indirect beneficiaries are is not known in advance by the central programme team. Considering the CAS programme, Master Teachers or Hub Leads would need to be diligent in recording who is attending events and gathering other support. Even if this were done, it would then be time consuming and potentially off-putting to routinely ask attendees about potential impacts on others. Sampling indirect beneficiaries in an evaluation directly is also time consuming and not necessarily productive. Indirect beneficiaries may not know that a curriculum resource was obtained by a colleague at a CAS event.

One way to address this is to focus on in-depth case studies by external evaluators, for example focused on a small number of CAS Hubs, an approach we have used effectively in two evaluations of the NCETM along with many other projects. If a longitudinal element was included, it would be possible to identify the ways in which impact or change diffuses through the Hub network and then in the schools of members. This type of study lends itself to social network analysis - a means of identifying both the number and form of relationships within networks.

The Further Mathematics Support Programme

The Further Mathematics Support Programme (FMSP) consists of activities aimed at increasing the take up of Further Mathematics A level as well as A and A/S level more generally. The FMSP includes projects focused on direct enrichment of the learning experience of both A level, FM and GCSE students, CPD for teachers and Further Mathematics tuition to enable small cohorts to take Further Mathematics who otherwise would not be able to do so. The FMSP has a number of parallels with CAS. It was established by stakeholders concerned about supporting FM and A level Mathematics more generally. The FMSP has a regional coordinator network that is in some regions is closely linked to HEIs. CAS differs from FMSP in its emphasis on peer to peer support and the Hub approach. The FMSP also works directly with students offering on-line and face to face tuition through a network of regional coordinators. This might be something CAS might wish to broker in the future to support small A level Computer Science cohorts who might otherwise not be able to take the subject at A level.

The FMSP has conducted a number of evaluations of its programme with a focus on quality and process. It also monitors the programme against a range of key performance indicators that are agreed as a condition of funding with the DfE. More recently, the FMSP has commissioned an evaluation that includes a strand of quantitative analysis. This aims to model the relationship between engagement in the FMSP and number of FM entries and school and pupil characteristics obtained from publicly available data. This analysis is enriched by interviews that will support the interpretation of the meaning of the statistical data.

The relevance to this for CAS is that it is potentially possible to directly assess the impact of its activity in relation to some final outcomes such as GCSE entries in secondary schools. One issue that arises here, similar to the issue raised above in relation to NCETM indirect beneficiaries, is the importance of routinely gathering data on engagement with CAS activity. The demands made of

CAS Hub leads and Master Teachers needs to be considered if additional data was routinely collected. The application of this approach to impacts in primary schools is more challenging as it is not clear what existing data could be used as an outcome measure. However, this is potentially possible on a case study basis.

5.4 Considerations for future evaluation

Key to future evaluation is identification of evaluation aims and of the intermediate and final outcomes.

The study of Master Teacher impact has, we believe, demonstrated the value and efficiency of a telephone interview approach. The data obtained is richer than that obtained through survey alone. We note, however, that the responses to request were relatively low, even though a total of 151 teachers had indicated they were willing to take part in an interview. However, the sample of 15 was of sufficient size so that in our analysis we appeared to be approaching the point of data-saturation, which occurs when new responses do not lead to new themes or issues emerging. Thus, it appears telephone interviews is an appropriate data collection strategy. The response rate might be increased by seeking to interview closer to the time of the CAS member survey, or by targeting participants in specific CAS events shortly after attendance.

To understand in more depth the process by which Hub networks develop successful a case study approach might be used to gather views of various stakeholders in networks.

Currently, there is much interest in randomised controlled trials and quasi-experimental methods. Such approaches are costly and require a very clear intervention with strong fidelity so we do not feel they are applicable to CAS's main programme. However, it may be appropriate for such methods to be employed to trial and evaluate specific, well-defined initiatives, for example, a face to face versus on-line training in a programming language which might lead to measurable outcomes.

6. Issues to consider

Given the scope of the study we report on here we do not consider it appropriate to make firm recommendations. Rather we propose in this section we summarise a number of issues for CAS to consider.

CAS organisation

1. Resourcing of Master Teachers and Hubs. The study indicates that CAS support for Master Teachers and Hubs leads to considerable 'added value' in terms of CPD. Further, support is needed for administration and marketing tasks to enable Master Teachers to focus on leadership activities.
2. The Master Teacher and other designations. As discussed above, for the next phase of development of CAS the appropriateness of 'Master Teacher' as a designation should be considered
3. More generally, CAs should consider the nature of the relationship between Master Teacher and Hub Leader activity as well as other aspects of the Network of Excellence. The need here may be for further clarification or changes to meet the next phase of CAS growth
4. Marketing. CAS should seek additional resource/funding to promote its activity and develop greater recognition of what it does.

The CAS offer

5. The study indicates the value of face to face support. Further on-line support is indicated for specific training such as in programming languages. CAS should consider the extent to which the offer made locally should vary from place to place.
6. There is potential to support computing in primary schools through making clearer links to other subjects and particularly mathematics. CAS should consider whether this should be a priority and if so how this should be undertaken.

CAS as part of a self-improving system

7. CAS should consider how to strengthen its network with the Teaching School Alliance network both to promote its work but also because Teaching Schools are effective Lead Schools or hosts for Hubs
8. CAS should consider mapping patterns of engagement and identify 'cold spots' to target areas for development.

Future evaluation

9. Regardless of whether for future independent evaluation or otherwise, CAS should consider identifying the intended impacts on teachers, teacher networks, schools, and pupils of activity. This would involve both in general and potentially specific impacts for particular aspects of the CAS programme
10. In planning future evaluation, CAS should consider lessons to be learnt from evaluation of comparator organisations and potentially seek advice directly from them and/or DfE representatives who work with these organisations
10. In seeking further funding, CAS should consider the extent to which independent evaluation is a priority and seek funding for this as appropriate.

7. Conclusion

Computing At School has swiftly developed a cadre of Master Teachers to support the development of computing in schools. This study indicates that Master Teachers and CAS more generally are well-regarded by teachers who have engaged with it. CAS is making a significant difference to the implementation of the new computing curriculum. We have identified a number of issues in the implementation of the programme which might be expected at this point in the rapid growth of a relatively new organisation. The study also has highlighted a number of more strategic issues for CAS to consider.

Annexe 1: Computing at School Study

Interview Schedule - Master Teacher

Introduction

We are conducting an independent study of the Computing at School Masters Teacher Programme. We are interviewing you because you are a Master Teacher.

Data collected will be stored confidentially. We will not identify teachers in reporting. All data will be stored securely on password protected computers.

Can you confirm that you have read the information sheet and that you are happy to take part in the interview?

{Take audio consent}

About your school

How would you describe the school?

Rural/urban/suburban, profile of pupils, attainment

Primary, secondary, FE?

About you

What is your current role in your school?

Which year groups taught/level etc

How long in that role? How long teaching?

For secondary probe original subject specialism and training

For primary probe year groups taught

Any further training in computing?

Computing in your school

How is computer teaching organised in your school?

How does computing relate to your role in school?

What are the main barriers to developing computing in your school?

Curriculum changes?

What has been the impact in changes in the curriculum?

prompt if needed on you? on teaching in your school? on colleagues

Involvement in CAS

When did you first become involved in Computing at School

Why did you become involved?

How did you become involved?

How did you become a Master Teacher?

Why did you become a Master Teacher?

(prompt if needed moral purpose - in relation to computing and also in relation to professional learning)

The Master Teacher role

Can you tell me about your role as a Master Teacher for computing at School? Probe: Clarify which level of engagement ie level 1, 2

How long have you had that role? What do you do as a Master Teacher?

- who do you support? - prompts numbers of teachers, types of schools teachers come from.

How do you support them?

Is face to face contact important? Could the same support be offered on-line? If not why not, what would be lost?

To what extent are you seen as a peer by those you work with?

Do you have any comments about being a peer and also being identified as an expert?

CAS activities, how do teachers come to take part in CAS? Other informal activities/contact

How do you feel the MT role could be improved (if at all)?

Benefits to participants

How have the teachers and schools you have worked with benefited from the work you have done with them as a Master Teacher

Prompts

Teachers - developed subject knowledge, change in beliefs, change in practices, confidence, career

Schools -increased offer of Computing, increased take up of Computing, - who, how

Any evidence of impact on pupils?

Benefits to you from being a master teacher

Developed subject knowledge, beliefs, change in practices, confidences, ability to lead PD, career benefits to master teachers' schools?

Support

What has supported you to do your role as a Master Teacher?

Computing at School - in what way, training, support, network,

School level support - how do school leaders in your school view your activity?

How important is the financial support?

Any other support - e.g other networks, associations

Barriers

Have there been any obstacles or barriers to being a Master Teacher?

School level other, how could these be overcome?

Other

What do you see as the main challenges for Computing at School in the next year?

What do you see as the main opportunities?

Do you have any other comments to make about Computing at School?

Do you have any other comments to make about teaching computing in schools today?

Computing At School Study

Interview Schedule - Participants

Introduction

We are conducting an independent study of the Computing At School Master Teacher Programme. We are interviewing you because you have participated in a Computing At School activity supported by a CAS Master Teacher

Data collected will be stored confidentially. We will not identify teachers in reporting. All data will be stored securely on password protected computers.

Can you confirm that you have read the information sheet and that you are happy to take part in the interview?

{Take audio consent}

About your school

How would you describe the school?

Rural/urban/suburban, profile of pupils, attainment

Primary/secondary

About you

What is your current role in your school?

Which year groups taught/level etc

How long in that role? How long teaching?

For secondary probe original subject specialism and training

For primary probe year groups taught

Any further training in computing?

Computing in your school

How is computer teaching organised in your school?

How does computing relate to your role in school?

What are the main barriers to developing computing in your school?

Curriculum changes?

What has been the impact in changes in the curriculum?

prompt if needed on you? on teaching in your school? on colleagues

Involvement in CAS

When did you first become involved in Computing at School?

Why did you become involved?

Probe purpose, motivation

How did you become involved?

Computing at School Activities

What CAS activities have you been involved in?

Master teacher led activities, other activities, forum, hubs

CAS activities are often led or facilitated by a local Master Teacher - someone who has expertise in Computing

Have you participated in any activities led by a Master teacher

When, what, where, who, why?

Do you have any comments on the support you received?

(what were your expectations, where those expectations met)

Are there any ways that support could be improved?

Have you received other support from CAS -e.g/ , on-line? Do you have any comments about this other support?

Benefits to participants

How have you benefited from participation in CAS activities/using CAS support?

General and specifically in relation to Master Teacher support?

Prompts:

Teachers - developed subject knowledge, change in beliefs, change in practices, confidence, career

Schools -increased offer of CT, increased take up of CT, - who, how

Any evidence of impact on pupils?

The form of support

Is face to face contact important? Could the same support be offered on-line? If not why not, what would be lost?

To what extent do you see the Master Teacher/CAS facilitator as a peer? To what extent do you see them as an expert?

Where else have you gained support/professional development in relation to computing?

What has been most important in supporting you to teach computing in school

Possible responses - Computing At School - in what way, training, support, network,

School level support -

Barriers

Have there been any obstacles or barriers to developing your capacity to teach computing

How could these be overcome?

Other comments

Are there any specific ways that the MT role/offer could be improved?

Do you have any other comments to make about Computing at School?

Do you have any other comments to make about teaching computing in schools today?

Annexe 2: Study of the impact of Computing At School Master Teachers programme: Information sheet

Computing At School (CAS) has asked the Centre for Education and Inclusion Research at Sheffield Hallam University to undertake a study of the impact of CAS Master Teachers. As part of the study we will interview both Master Teachers and participants in activities they lead. The outcomes of the study will be reported to Computing At School to inform their planning and potentially will be shared with their funders. Outcomes may inform further publication by CAS, members of CAS or Sheffield Hallam University. The report of the study to CAS will not identify teachers and schools who take part in the interviews and in general participants will not be identified in any reports or publications arising from the study. Interviews will be conducted by Dr Mark Boylan and Ben Willis, of Sheffield Hallam University.

Why you have been invited to take part.

You have been invited to take part either 1) because you are member of CAS who has indicated in a survey you are willing to be interviewed or 2) because you are a CAS master teacher.

What taking part will involve

Each participant in the study will take part in a 30-45 minute telephone interview at a time that is convenient for you. You will be asked about your teaching of Computing in school, your involvement with CAS and your views on CAS activity. Interviews will be recorded and extracts or the full interview may transcribed either by a SHU researcher or a professional transcriber. At the start of the interview you will be asked if you consent to taking part and this will be recorded.

Data storage

Data collected will be stored confidentially. The report of the study to CAS will not identify teachers and schools who take part in the interviews and in general participants will not be identified in any reports or publications arising from the study.

All data will be stored securely on password protected computers. The study has been approved by Sheffield Hallam University's ethical process and will be conducted in line with SHU's ethics procedures, which are consistent with guidelines from the British Educational Research Association and the British Sociological Association.

For more information contact

Ben Willis

Centre for Education & Inclusion Research

Unit 7 Science Park, Sheffield, S1 1WB

E: B. Willis@shu.ac.uk

Tel: 0114 225 6059

Alternatively, the Computing At School lead for this study is

Dr Sue Sentance

National Academic Coordinator (Certificate, Research)

Computing At School

E: sue.sentance@computingatschool.org.uk

Annexe 3: Initial sampling strategy and rationale

CAS members who have participated in Master Teacher activities

CAS supplied data on n=151 CAS members who had indicated in a survey they were willing to be interviewed. Of these n=140 identified as suitable for the study.

A key characteristic of schools in relation to teaching computing is whether they are primary or secondary teachers; 21% of teachers in the sample of 140 were primary teachers. However, we purposefully oversampled n=6 primary teachers of 16 teachers in total (38%). This is to ensure variation within the sample of primary teachers and also to reflect the importance of this area of the work of CAS. A second variable used was the participants' responses to a survey question on how useful they found support from CAS Master Teachers.

Summary for sampling	View of master teacher training				
	Total	Not at all useful	Part useful	Useful	Very useful
Primary	30	0	4	17	9
Sample	6	0	1	3	2
Secondary	110	1	25	39	45
Sample	10	0	3	3	4
Population total	140	1	29	56	54
Sample total	16	0	4	6	6
Percentage pop		0.7	20.7	40.0	38.6
Percentage sample		0.0	25.0	37.5	37.5

We also considered using an additional variable for secondary teachers as to whether or not the school offered Computing as a discrete GCSE - taken as an indicator of the school base line in relation to computing. However, the response rate to initial emails indicates that obtaining a sample on the first two variables will potentially be demanding, although achievable. So the GCSE

characteristic was not taken into account in sampling secondary schools. This characteristic will be reported on in considering the representativeness of the sample.

CAS Master Teachers

The intention is to interview a total of 8 Master Teachers. Given this is a small number in relation to the total population the aim is to purposefully sample for the range of characteristics rather than aiming for a representative sample.

CAS supplied a data base of 332 Master Teachers. Additional data was provided separately on withdrawn Master Teachers which was used to confirm the Master Teacher database was up to date. Level 1 Master teachers (n=131) were excluded from the sample, on the advice of CAS, as they were still undergoing subject knowledge training. In addition a further 10 were excluded as there was no data on funding status and an additional 1 who was listed as 'independent'.

Variables used for the remaining sample were Master Teacher Level, funding/unfunded and also for Level 2 teachers - Primary/Secondary.

The number of Master Teachers by level were n=177 (4%), Level 3, n=11 (6%). However note that of the 10 excluded from the sample due to no data on funding status, n=7 were Level 3 teachers, so in the Level 3 teachers are approximately 10% of the total number of Level 2 and Level 3 Master Teachers.

Sampling Level 3 Master Teachers

The Level 3 Master teachers are likely to have roles as regional coordinators. Characteristics of Level 3 Master teachers are eight funded, all secondary, and 3 unfunded Level 3 teachers of whom two are primary and one secondary based.

A purposeful sample of 2 Level 3 Master Teachers will be sought.

Sampling Level 2 Master Teachers

The table below shows the characteristics of Level 2 Master teachers

	Frequency	Primary	Secondary
Funded	120	61	58
Unfunded	59	18	41

Given this, the proposed sample of Level 2 Master Teachers is n=2 Primary funded, n=2 Secondary funded, n=1 Primary unfunded, and n=1 secondary unfunded.

Sheffield Hallam University

Independent study of computing at School Master Teacher programme

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