



PROFESSIONAL ASSOCIATION ACTIVITY: WHAT CONTRIBUTION CAN IT
MAKE TO MATHEMATICS TEACHERS' PROFESSIONAL DEVELOPMENT AND
STUDENT LEARNING, AND ARE ANY ASPECTS OF THAT DISTINCTIVE?

FINAL REPORT

DR JENNIE GOLDING, UCL INSTITUTE OF EDUCATION

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ABSTRACT

Professional association activity is commonly regarded as a professional 'good' (Cherwin 2010), yet there remains little systematic evidence of its impact on teachers' development or the learning of their students. At a time when there are a variety of threats to the quality and quantity of mathematically-effective teaching (Ofsted 2012) this small study asks what contribution participation in mathematics professional association activity can make to the development of teachers' knowledge, skills and affect, and how that then impacts on their students. Questionnaire and interview data were collected from participants at a variety of mathematics professional association conferences, and a grounded approach was adopted to data analysis and interpretation. Participants claim a range of significant and pervasive benefits to their professional association participation, many of which are distinctive to this form of professional development. These include a renewed commitment to their role as teachers of mathematics. They talk about refreshment and inspiration, and about deep and lasting impact on them and on their students' learning. They offer suggestions for improving impact further, and also describe a number of disincentives to engage in such activity. Implications of the findings are discussed.

CONTENTS

ABSTRACT	2
SUMMARY	4
BACKGROUND	5
The UK mathematics education professional associations.....	5
The role of professional associations in teacher development.....	6
Characteristics of effective professional development.....	6
THE STUDY	7
FINDINGS AND DISCUSSION	8
Identity and values.....	8
Specific gains for teachers and/or students.....	9
Strengths and limitations of professional association activity.....	11
Benefits distinctive to professional association activity.....	12
Threats or disincentives to such activity.....	13
<i>Further Discussion</i>	14
CONCLUSIONS	15
REFERENCES	16
Appendix A: interview questions	17
Appendix B: Questionnaire	17
Appendix c: Questionnaire question 1 responses.....	18
Appendix D: interviewees	18

SUMMARY

- This small systematic study draws largely on data from participants recruited via the 2016 ATM, MA, NAMA and NANAMIC conferences, through questionnaires (n=185) and interviews (n=16).
- All interviewees were outspoken about the **positive impact of professional association activity on their professional identity**, including the affirmation of their role as teachers of mathematics, their self-efficacy, and the renewal of their core beliefs about education in general and mathematics education in particular. This was sometimes expressed in extravagant terms ('life-changing', 'my ongoing inspiration', 'unquantifiable') and on several occasions was expressly linked with retention in the classroom.
- **Direct benefits to professional expertise** were claimed, including the building of capacity for long-term development, creative and imaginative ways of enhancing learning, specific knowledge and skills that could be taken straight into the classroom, and understanding of other phases and contexts for mathematics education.
- Interviewees were eager to stress the **direct impact on their students** of exposure to new classroom resources and ideas, as well as the long-term impact of having a confident, refreshed, enthusiastic and more mathematically-knowledgeable teacher.
- Teachers identify **threats** to their, or others', ability to participate in professional association development activity arising from a lack of funding for, and management valuing of, opportunities such as face-to-face conferences. They describe school and college leaders as often reluctant to invest in long-term development because a teacher might not then stay in the institution.
- Teachers identify **twilight or weekend meetings** of professional associations as offering some of the same benefits as residential conferences. These are complemented by professional association periodicals and newsletters that provide ideas and awareness of wider and national issues. Some teachers particularly appreciate opportunities to contribute to national policy debates.
- Participants pointed to **some areas of teacher development better provided elsewhere**, such as core subject knowledge or skills enhancement. These particularly benefit from the longitudinal exposure interspersed by classroom experience that professional association development does not currently provide. Teachers of all phases also value development alongside their own school/college colleagues that is readily applicable to their shared context.
- Questionnaire responses (n=185) are broadly consistent with interview data, although in less depth. They show that participants greatly value the **very high quality, personalised, deep and wide provision** of the mathematics professional association conferences, much of which is not available elsewhere. Many recognise distance learning opportunities as appropriate for particular kinds of learning, but suggest they are no substitute for the intensive and affirming deep and wide learning possible in face to face development. A significant majority also greatly value opportunities to **engage with new ideas and mathematics**, and are professionally refreshed by them, irrespective of their immediate application to the classroom.
- For all teachers, but those in Further or Community Education in particular, professional association activity can provide a **subject-specific professional community** often lacking in their workplace, and this can be central to their identity and continued commitment in their professional role.
- Teacher development opportunities overlap with those provided elsewhere, although the quality assurance is said to be unusually high. However, professional association activity is claimed to offer a **number of distinctive benefits hard to find elsewhere**. Apart from professional affirmation and contribution to teachers' professional identity, there is opportunity to shape development to a profile of individual needs. There are rare, and highly valued, opportunities to do mathematics, whether at a classroom or adult level, and so to re-ignite enthusiasm for the subject. Teachers can work with a wide variety of colleagues to develop teaching and learning materials in a variety of formats, to debate and influence policy, to present their work and local enquiry, and to support the development of others. These experiences not only serve to renew teachers' enthusiasm and commitment, but they add to both individual and systemic capacity.

BACKGROUND

We know quite a lot about some characteristics of effective mathematics teacher professional development (PD), for example that it is grounded in classroom practice, sustained, personalised to the development needs of the teacher, etc. (Joubert and Sutherland 2008); and also about teachers learning from everyday experience (e.g. Eraut 2004). Fan (2014) suggests that the most important sources of teachers' knowledge are their own teaching experience and their informal interactions with colleagues. However, unless that is complemented by external challenge and ideas, there is a danger of unfounded complacency and stagnation. There are some sizeable gaps in the PD literature, e.g. the affordances of online activity continue to change rapidly and there is very little evidence of the impact PD activity has on students' learning. Further, I cannot find any systematic study of the contribution professional association activity can make to teachers' development, or hence to their students' learning.

THE UK MATHEMATICS EDUCATION PROFESSIONAL ASSOCIATIONS

Within mathematics education in the UK, there are at least four national 'classroom-facing' professional associations, funded entirely from membership. The Mathematical Association, established in 1871 as the 'Association for the Improvement of Geometrical Teaching', now takes as its remit 'supporting and promoting confidence and enjoyment in mathematics for all'. Initially the MA was focused on the needs of academically-inclined young people, but The Association for Teaching Aids in Mathematics (ATAM) was founded in 1952 with the aim that *all* children should learn mathematics through lively and interesting experiences. ATM (the Association of Teachers of Mathematics) now seeks to support teachers to explore strategies that will enable learners to enjoy and discover mathematics. Both associations welcome teachers of mathematics in all phases and institutions, as well as others with an interest in mathematics education. In contrast, NANAMIC, the National Association for Numeracy and Mathematics in Colleges and founded in 1993, is focused on the needs of those working in the post-16 learning and skills sector. The National Association for Mathematics Advisers, NAMA, is open to all seeking to improve mathematics education beyond their own organisation and includes advisers, consultants, lecturers, researchers and inspectors. NAMA provides advice, support and inspection services to individuals and organisations that seek to make an effective contribution to the learning and teaching of mathematics. The larger associations represent several thousand individual members as well as institutions, and all are involved in proactive and reactive work in relation to pre-university mathematics education policy and practice. Some publish periodicals, but all claim that the development and support of teachers of (numeracy and) mathematics, and those who work with them, is at the core of their purpose.

There is variety in the professional development activities offered by the four associations, but much too that is in common. Between them they offer not only annual residential conferences but a range of day conferences, bespoke courses, professional periodicals, twilight, weekend and evening local groups and a variety of social media opportunities. All these offer ways in which practitioners can build up knowledge and skills through professional communities beyond their own institution. Additionally, the larger ones develop resources written by member(s) for publication. Hodgen (2007) suggests this in itself can develop teacher reflection, knowledge and hence practice. Through affiliation with a professional association, therefore, teachers can vary in extent and type of involvement: some participate in leadership or committees, some write for journals, some are active in a local branch of the MA and/or ATM (many branches are joint), meeting twilight or on Saturdays. Some are active in association social media or avid producers or consumers of association publications; others actively contribute to national education policy development and discussion, through their association and via the Joint Mathematical Council. A member might simply receive newsletters and journals or might be involved with some or all of the above. It is reasonable to

assume that those contributing to this study were among the more active members, most having committed to a residential conference, many of them in holiday time and some at their own expense.

Of these, the Easter annual conferences (NAMA, ATM and MA) are residential over three or four days, although day attendance is possible, whereas the NANAMIC conference is one day only. Within each, though, there are a variety of sessions, some plenary and others within parallel strands. These might focus on particular mathematics pedagogic knowledge or skills, ideas for learner enrichment or teachers' own mathematics enhancement and/or enjoyment, mathematics education curriculum, leadership or assessment issues... Sessions take the form of lectures, workshops, discussions, presentation of work, etc., and, particularly in residential conferences, there is plenty of time for professional networking and also some for social activities. Not all participants are practising teachers or teacher educators, but all have a knowledge of and interest in school/college mathematics.

THE ROLE OF PROFESSIONAL ASSOCIATIONS IN TEACHER DEVELOPMENT

This study will evidence the perceived contribution of professional association activity to the professional development of some teachers of mathematics who engage actively with it. Chetwin (2010) suggests there are likely to be gains from networking, development of knowledge and/or skills, and taking responsibility for one's development. I was unable to find any other literature addressing the question. However, the importance of professional development and career progression in combating the main reasons teachers leave the professions is well evidenced in Smithers and Robinson (2003). 36% of their sample teachers considering leaving, and over 50% of their teachers considering moving, cited opportunities for professional development as 'of great importance' in determining their actions.

Similarly, evidence for the perceived relative effectiveness of professional development from different sources is sparse, as is the process by which teachers develop their professional knowledge. Both these areas are addressed for groups of teachers in Chicago and in Singapore by Fan (2014). Fan does not address teacher development through professional associations directly, but he does show that his sample teachers gave great value to informal exchanges with colleagues, and that the Chicago teachers particularly valued development at a national or regional level. Singapore teachers are of course working on a smaller national scale. Unfortunately, Fan gives no further detail, for example about why teachers claim to particularly value such opportunities.

CHARACTERISTICS OF EFFECTIVE PROFESSIONAL DEVELOPMENT FOR TEACHERS OF MATHEMATICS

Professional development can be enjoyable without being effective, that is, succeeding in meeting its goals. These goals are not always spelt out, but Joubert and Sutherland (2008) summarise what the literature tells us about effective professional development for teachers of mathematics as follows:

- based on sound educational practice
- sustained over time, preferably alternating input with related classroom experience
- commitment by both institutions and teachers;
- supporting purposeful networking amongst teachers;
- grounded in the classroom;
- personalised, starting from where teachers are and how they want to develop;
- focused on 'mathematics for teaching' (subject and subject pedagogical knowledge);
- centred around activities that reveal aspects of 1) teachers' awareness, beliefs, and knowledge 2) teachers' practice and 3) students' learning;
- supporting reflection and inquiry by teachers focused on their own learning and their practice.

Desimone (2011) adds that teachers need to be actively learning. However, recent work on teachers' occupational capacity (Golding 2016) suggests that unless teachers also enjoy positive affect in relation to their work, including positive self-efficacy, resilience, enthusiasm and feeling valued, they are unlikely to be able to maintain development of their practice.

How does the range of mathematics professional association activity match up to these characteristics? The structures available certainly support networking and can easily be personalised. Other aspects were probed through fieldwork.

THE STUDY

I adopted a constructivist grounded approach (Charmaz, 2006) with a non-representative sample: there is no claim to generalisation here, although the study shows clearly the breadth and depth of impact on some teachers of their involvement in professional association (PA) activity.

For each of the NAMA, ATM, MA 2016 Spring conferences and for the NANAMIC Summer 2016 conference, I provided a background flyer for each participant and collected data as follows:

1. Four 30-minute semi-structured interviews from a purposive sample of conference participants who are either based in the classroom or were until recently. These included at least one with each of the following characteristics: early/late career; beginner/seasoned conference participant and association member; Primary/Secondary or post-16 working contexts (though NANAMIC was limited to post-16 contexts). Participants were approached for voluntary participation and given a cool-off period. I gave them a semi-structured interview at their convenience, and interviews were recorded and transcribed. These were later offered for participant validation and possible expansion.
2. All conference participants were invited to answer a common post-conference questionnaire with a mix of Likert-style and open questions; they were invited to send any additional related thoughts to me by email. Details of these two methods of data collection are given in the Appendices.

Additionally, I scrutinised documents available on professional association websites (www.atm.org.uk; www.m-a.org.uk; www.nama.org.uk and www.nanamic.org.uk), and at conferences, including a large range of association publications. A similar approach was taken for the NANAMIC Summer 2016 conference adding data largely from teachers in Further Education.

Grounded analysis of all qualitative data was by open, axial and selective coding; some quantitative analysis of Likert-style items was also undertaken. Serendipitously, I was able to work with a trained researcher and experienced senior teacher who was able to validate coding and interpretations independently as a 'critical friend'. This was particularly important as I have a history of involvement in professional association activity, so was very much an 'insider' to the research. I therefore took care to actively seek omissions and counter-narratives within the data; nevertheless, participants will have been aware of some of my affiliation. The purpose of questionnaires was to solicit values attributed to a range of aspects of professional association activity, particularly conferences, and to validate interview responses by sampling from a wider audience. Findings are situated within the literature. Final data, Summer 2016, comprised 16 interviews, a total 185 questionnaires (about a 45% response rate), and six further electronic communications. All contributions have been anonymised for reporting purposes. Interviewees have been given pseudonyms as outlined in Appendix 3, where I also summarise their professional background. They either are or have recently (with one exception) been practising teachers: I refer to them as 'teachers'.

Throughout, though, the study is framed by its reliance on 'teacher' accounts. The status of such claims has been contested: do teacher narratives represent warranted true belief, and if not, to what extent can they be represented as 'truth'? This issue is addressed in the literature, and I adopt here Doyle's (1997) position applied to teacher development, that the study aims to develop understanding of a highly contextualised and personal phenomenon, through access to participants' stories of intentions, motives, purposes and perceptions of effectiveness, rather than a universally knowable phenomenon susceptible to legislation through policy. Truth in this instance is an outcome of the interaction of theory, observation, interpretation and scrutiny by the variety of experts to whom teacher development matters – a communal achievement.

FINDINGS AND DISCUSSION

Open and axial coding of data exposed themes around: identity and values, specific gains for teachers and/or students, strengths and limitations of professional association activity, and threats or disincentives to such activity. I consider each of those in turn. Whilst it was not possible to operationalise either questionnaires or interviews in precisely comparable ways across the four associations, I argue any differences were unlikely to have fundamentally affected responses.

IDENTITY AND VALUES

Interviewees were keen to talk about impact on their professional identity or values, often in terms of affirmation, empowerment and meeting with like-minded people who support and challenge them professionally: for 11 of 16 this was their first focus in response. It was centred around face to face participation at conferences, at local branch meetings, or in working on professional association publications or committees. Many feel a great sense of community, sometimes built up over years, and talk about refreshment and renewal, often contrasting that with the draining nature of teaching:

It gives you confidence and camaraderie to mediate the pressure and turn it into something constructive because here it's a shared enterprise. (Billy)

Wonderfully supportive – you share the challenges and the satisfactions. (Gail)

It's a safe place where I can nurture my professional being in the company of people who have similar values but stimulatingly different ways of working them out. It recharges and fulfils me so I go back to school renewed and re-committed in my mindset and aspirations. (Kathy)

It gives me an opportunity to rediscover my creativity, that gets drained over time with all the pressures, and also to just enjoy the maths, re-discover why it was I came into mathematics teaching, so that I return a different person – I really do – completely recharged and re-committed. (Lara)

Claims were often extravagant: 'It's been a lifechanger, it builds me up as a maths teacher so I can do a better job in the classroom' (Kim) and this was sometimes (for four teachers) specifically linked with retention in teaching:

PA activity helps me to analyse, and then be proactive about developing what I value. Hugely empowering, and has to be one of the things that keeps me in the profession despite the grinding demands. (Lara)

Here is about personal professional development, affirmation, values – challenge too, but support to develop that deep thinking that nurtures your long-term growth and enablement, that enables you to go back refreshed and keeps you committed to what can be a very, very draining profession – I just couldn't stay in my job long-term without that injection of positivity and recharging. (Billy)

For interviewees with a background in Further or Community Education, this identity work was talked about in more fundamental terms:

In FE, very often you don't even see other teachers of maths – you teach at different times, and different sets of students. 'Professional development' is often seen as a cascading of the latest government initiative, generic and passive – subject specific PD is really quite unusual, except in exceptional colleges.

So NANAMIC gives you that identity – there are other people out there struggling with you, valuing some of the same things as you do – otherwise you’re just functioning in isolation, far too often. (Sally)

We do have district development occasionally – but it’s generic, never subject specific, let alone subject- and level- specific. Twice in my eight years we’ve had that, so when my line manager said ‘here’s a course, would you like to go’ I couldn’t believe that anyone was taking my subject specific needs seriously. It’s not about my subject knowledge of course – it’s about sharing what I do and my challenges, and having the opportunity to discuss new ideas and other people’s approaches. I’m not a joiner, but being able to identify with what people are talking about, and having something that addresses my very specific needs, that’s unheard of until now. (David)

SPECIFIC GAINS FOR TEACHERS AND/OR STUDENTS

Interviewees commonly talked about the high quality of professional association publications and resources in terms of direct benefit to themselves and their students:

There are always really practical ideas that I can pick up and tweak and use for my students, as well as articles that make you think deeply about how you’re approaching something. (Rachel)

The PA resources are excellent, and all very well trialled. So it’s all very developmental and lifts your practice to another plane. (Graham)

Often the benefit was claimed to spread beyond the interviewee concerned:

I’ve worked with teachers using these materials and boy are they effective. If they can make the right selection and the right tweaks, and we work on that, then they see real and immediate impact on learning. (Graham)

However, a substantial body of interviewees’ comments was directed at the range of immediate and long-term benefits they perceive from participation in conferences and branch activities:

Support-inspiration-resources – I return brimming over with ideas and enthusiasm, with knowledge about innovations across the country, catholic ideas and approaches that have worked in different circumstances. The resources are creative and engaging, they really probe deep understanding and the students love them. (Terry)

You do maths, you refresh old ideas and get new ones, you think very hard and that’s something that can get lost.... You make the links between what’s important in teaching and later, what’s important in leading and managing. (Janet)

Mix of phase and geographical spread is enriching, you get a wide range of information, ideas, liveliness and fun, maths stretch sometimes, you meet new ways of doing things, new ways to think about things... at the same time to rediscover this wonderful world of mathematics and get recharged in the kind of thinking and wonder that you want your students to catch. (Jackie)

Many respondents (15 questionnaire responses and 6 interviewees) identified informal networking opportunities as some of the most valuable, for both the short- and longer term:

(...At conferences) usually the most valuable times were outside the sessions – the sessions are valuable, for a variety of reasons, but for me the most valuable are the times when you’re chatting outside sessions. So you get these people with really big ideas...so stimulating, even if you don’t always agree or see how

they can fit your situation, they challenge you That, and the sessions, really recharge you as a teacher, and you'd feel yes, I can make a good job of this and it's worth investing the effort. So through those experiences I met people who've become good friends over the years, and have led to all sort of other opportunities and ways of thinking about mathematics and mathematics education. (Charles)

Teachers were explicit about the benefits to students, and the long-term nature of the benefits. This was not always in terms of easily-measurable short-term impact, but about the foundations for sustained learning and positive disposition towards mathematics (Kilpatrick et al. 2001):

Provision is at a high level: it's really high quality and builds your subject knowledge so it's deeper, I think. There's also the smaller things you pick up or learn, but the difference is in building for the long-term and the big picture. I take away things I can use straight away and that really hook the kids but also strategies for their sustained learning and positive attitude to maths. (Lara)

I've always come back with some 'whizzy', high-impact ideas, but also some sound, long-term inspiration and routine ideas for the classroom. And through my career not only have those impacted on my students directly – they'd think it was a bit weird to go on a maths holiday but they really rather like the neat or elegant or downright ditzy ideas I brought back, and they'd remember some of those years later – but it also impacted on my department, got written into a scheme of work, and then onto beginner teachers. So there's a ripple of benefit that's almost unquantifiable, and it does wonders for the range of those people's disposition towards mathematics. (Jackie)

The residentials – they're absolutely brilliant – like-minded people, shared ideas, world class experts sometimes, so you get information and ideas as well as confidence and affirmation, some ideas for tomorrow but what's really more important, you build that deep pedagogical thinking, the whole problem solving approach and underlying ideas and how you build for those rather than a short term thing. It's more empowering, getting the tools. It's the whole experience of meeting people and living it – it can be inspirational. And then what you take back to your students, is better, lively, well-informed ideas, wider aspects, building for the long-term – just a wholly enriched teaching. (Rachel)

The specific numeracy ideas, I took them straight back to my classroom and my students are already showing the benefits, in a couple of weeks. There are also 'seed' ideas, things that get me thinking and will come to fruition over a longer timescale – but those sorts of sessions not only give me specific ideas but give me the confidence to pursue new ideas, and a community to share them with if they work – or even if they don't! (Susan)

For some (seven interviewees and over 25 questionnaire responses), the opportunity to be better informed about, and contribute to, national policy debate is valued; for others (in six interviews and some 15 questionnaires), the chance to engage with cutting-edge research relevant to their practice and reflect on its application is important. For teachers who engage in local branch meetings, the benefits are also very clear, though somewhat different:

Conference is a mega-shot in the arm, but branch meetings keep me fed during the year. They're when I can turn up absolutely drained, with what seems a raft of insurmountable problems, and they refocus me on why I came into the job in the first place. They don't ignore the realities of Monday to Friday, when you might genuinely feel like giving up, but they keep them in perspective and you feel supported and recharged to face Monday, with some good ideas as well. (Kim).

Questionnaire open responses were usually in less depth, but generally consistent with these strands.

STRENGTHS AND LIMITATIONS OF PROFESSIONAL ASSOCIATION ACTIVITY

As well as the specific benefits to professional skills and knowledge, and to professional affect and identity, teachers identified the eclectic nature of professional association activity, and the fact that they can easily personalise it to their own professional needs, as underpinning its effectiveness. Many describe it as 'uniformly high quality – the best professional development I get' or similar. As above, professional association activity was often described as having long-term benefits for both teachers and their students. Interviewees contrast this with other face to face courses which are usually '*very focused on short-term skill or particular knowledge*' (Janet).

Other day courses are in comparison very thin - based on a particular skill or giving you information. These (professional association events) give you excitement and interest to take into the classroom - and recharge you mathematically – they're much more holistic and you can choose the selection of input that's what you need at this time. And it gives your students a much wider view of what mathematics is and what it can do. (Charles)

Teachers said they found distance learning can be effective for pure dissemination of information. Five interviewees talked about the benefits of being physically removed from their work environment and the luxury of sustained unhindered time committed to their professional growth. Several teachers described the desirability of also participating in school/college-based development alongside colleagues with whom they were going to be working, with access to familiar resources, and with whom they could contextualise new ideas; in three cases they extolled the particular advantages of engaging in branch or conference activity with at least one colleague. Some identified conference activity as being limited by a 'light touch' or 'taster' for more substantial knowledge or skill development, particularly where there was a need for substantial subject or subject pedagogical knowledge, better provided in a series of inputs interspersed by classroom embedding. This was true in particular for two of the NANAMIC participants, for whom the annual conference is only one day. One commented

And of course then you go back into college and there's no-one to share it with, no-one that understands, so unless you're really committed, those interesting ideas and good intentions might well get lost. (Angela)

Most of these comments were echoed in questionnaire responses, where Likert scale items largely concentrated on features of conferences. The table in Appendix C shows average response by conference attended, where the questions are reproduced in full in Appendix B and participants responded on a scale of 1 (of little importance to me) to 5 (very important to me). Items with the highest scores from each association are highlighted. It is clear that for the range of participants, meeting with mathematics education professionals with a variety of roles and experiences is highly valued, as are opportunities to engage with new ideas or mathematics. They also value opportunities to choose sessions, that is, to make the experience fit their own needs, in line with ACME's (2016) forthcoming report suggesting teacher development provision should be at least partially individualised. Not all participants at these conferences are practising teachers or working with practising teachers, but if the responses of non-active teachers are excluded, similar patterns are seen. Note that qualitative responses across associations were highly comparable. Apparent differences in 'scores' across associations would appear to be largely a question of individual calibration: all these aspects would appear to be valued, and the *ranking* of values is similar. Response rates across associations varied, partly because of the precise way in which questionnaires were administered.

Teachers identify some sorts of professional development as better provided by other means, particularly if they involve substantial subject knowledge or skill development, which benefit from sustained input interspersed by classroom experience: professional association activity can only offer limited exposure over limited periods of time. In parallel with the rich opportunities afforded by professional association activity and its horizon-extending mix of teachers, they also value opportunities to work with their own

school/college colleagues to develop ideas in contextualised ways with local resources. Some use electronic media for discussion at a time that suits them, or for dissemination of information – and they value the electronic resources and discussions hosted by the professional association websites and discussion routes. However, all of those interviewed and virtually all of those completing questionnaires identified face to face professional activity as a central and rich component of their development and of their effective impact on students.

BENEFITS DISTINCTIVE TO PROFESSIONAL ASSOCIATION ACTIVITY

Participants were clear that even where conferences last for four days, they are typically structured to provide a range of inputs and stimulus, rather than addressing teacher development that needs sustained exposure, perhaps interspersed with classroom experience. There is some evidence (Joubert and Sutherland 2008) that sizeable teacher subject and subject pedagogic needs are best developed in such a way. However, some of the specific claims made suggest that teachers are confident specific pedagogic tools or comparatively small new areas of mathematics knowledge can be very satisfactorily addressed in professional association conferences, where teachers also benefit from a range of expertise from colleagues. Many of the benefits claimed from professional association participation are also available elsewhere – for example, in England at present there are a variety of centrally-funded initiatives structured to provide professional development (PD) for teachers around key government priorities. Are there, though, any benefits which appear to be distinctive to professional association activity?

This study suggests several such. First, there is the opportunity to mould PD, whether in terms of reading, resources or face to face development, to one's own professional needs:

I looked at the programme with my line manager, but at the end of the day, it's up to me: there are sessions I ought to go to so I'm in touch with national developments, there are sessions I ought to go to for the furtherance of my own classroom practice – perhaps that will give me techniques or the confidence to have a go when I don't have to but I think I ought to – and then there are the things that just recharge me as a teacher of mathematics. They might be fun, surprising, perhaps wacky things to do in the classroom, but they might be a nifty piece of mathematics that reminds me what a wonderful subject this is. It might or might not get as far as my students, but the point is, it recharges me, so I go back a better teacher. So that's really empowering, being able to fit the programme to my needs, not what someone else thinks my needs should be. (Jackie)

Note there the reference to working with mathematics – for its own sake as well as for possible classroom benefits. In England this is unusual once teachers have qualified, especially if that fits them to be regarded as 'subject specialists', yet this aspect of PA conferences was highly valued across participants.

There appears to be a great deal of professional affirmation, networking and identity work going on, of which this is part – not least among Further Education and Community teachers, who in general have little access to colleagues in comparable roles. Other teachers particularly value the access to recent research offered by the PAs, and/or the informed policy work facilitated by PAs based on professional discussion. I would argue it is healthy for policy systems to be informed by such knowledge and discussion. Finally, through the PAs it is relatively easy for teachers to be able to offer something back to the professional development of others. Some take advantage of the opportunity as a teacher to write about their professional work, or to give a session at a conference – to disseminate and have that critiqued and discussed in a varied but informed peer group. Others choose to work on committees that produce

resources or develop courses, often engaging in writing work that responds to longstanding and deep desires to improve mathematics learning.

You do it because you want to support other people, particularly beginner teachers – but in doing so you find you actually have to reflect and develop much further yourself to articulate exactly what it is you want to share and why. (Billy)

Writing for journals has been very developmental, and the support you get for doing that. Very high quality writing sessions: a richness of ideas from people whose ideas have since shaped my practice, that I admire and aspire to. Not in a dogmatic way, but in a reasoned and steeped-in-practice way. (Charles)

Such participation can also bring substantial benefit to a teacher's identity and commitment to the profession, as they choose to take actions that can make a substantial difference, as opposed to reacting to a change in central policy - though they might do that too. In England, some of these benefits are now being promulgated – and funded - through central initiatives such as the 'Maths Hubs', yet teachers still value choosing to participate in PA activity independently:

It's partly that I know this is something I've taken responsibility for. I've decided, encouraged by others, that perhaps I do have something to offer, I've gone out and done it, and I've had fantastic feedback – it's very affirming, actually, and it's opened doors in my mind to new possibilities. And I take that fresh, enthusiastic teacher back into school. (Lara)

In summary, PA activity can offer teacher development benefits available elsewhere, but it also routinely offers a raft of distinctive affordances, many of them associated with professional identity, commitment to the profession and classroom-related sharing and recharging.

THREATS OR DISINCENTIVES TO SUCH ACTIVITY

There are, though, some clear threats to participation, of which funding was mentioned by nearly all interviewees. Although '*cheaper for several days of exceptionally high quality development than many mediocre commercial courses*' (Rachel), teachers routinely talked of school and college leaders prioritising performance-framed one-off courses for funding and not valuing the '*deeper, wider learning that is supported by face to face professional association opportunities*' (Janet). Others said that colleagues '*thought they were mad to spend holiday time at a professional conference when there are so many pressures during term time you just want to curl up and die when you get to a holiday*' (Kathy).

For Kim, the benefits of the conference are measured in terms of the lengths she is prepared to go to in order to attend, leaving husband and holiday and paying for herself even though she is earning considerably less than in her previous job – but not all teachers are in a position to do that. Three interviewees claimed that their schools would not pay for them to go to a conference because a better-informed teacher was more likely to move, and a fourth, Janet, framed this in terms of '*senior leaders, particularly in smaller schools, don't see professional development in terms of boosting the system, only in terms of their own school, and if it's going to lead to a teacher seeking pastures new, then they're not going to support it*'. Funding was a particular issue for those working in FE, with a majority of questionnaire respondents from FE reporting little or no support in their colleges for subject-specific development. Finally, two longstanding professional association members identified a threat from DfE-funded bodies with effective marketing of subsidised or free courses as undermining viability and competitiveness of professional association activity.

Four interviewees suggested that primary teachers without a strong mathematical background or a specific mathematics responsibility were unlikely to prioritise participation in subject specific professional

development. They suggested incentives for primary teachers to 'bring a friend', from a local or their own school, might increase both confidence and impact, and identified day conferences as a good first step 'where it's often desperately needed' (Janet).

Interviewees and questionnaire respondents identified a number of areas where they felt professional association activity, particularly conferences, could be further improved, but these were comparatively minor and largely organisational in nature.

FURTHER DISCUSSION

It is important to note that there is no claim to generalisability here: the teachers who attend these conferences are choosing to do so, often in their holiday, in precious family time. Many fund both membership and conference themselves, rather than being funded by their institutions: they clearly value what they perceive as its benefits. Some of them also take part in face to face activity between annual conferences, e.g. NAMA Saturday events or MA/ATM local branch events. As such, they are highly committed to their own development as teachers, but also claim that they gain motivation and energy for their job from such activity. Perhaps such a virtuous circle could apply to many more teachers. It is striking that almost all interviewees privilege talk about values, affirmation of professional identity, and improved self-efficacy in their accounts, together with deep, wide and reflective mathematical (subject and subject pedagogical) learning for the long-term effective exercise of their professional role. They commonly contrast such benefits with 'very focused, specific and short-term' (Janet) gains from much external professional development and often generic provision within schools/colleges or groups of institutions. I would argue that with pre-service education in England, whether school-led or HE-led, increasingly using generic rather than subject-specific input, such subject-specific opportunities are central to the development of a deeply effective teaching profession.

How do the benefits described by conference participants compare with what is known about effective teacher development? Responses in interviews and questionnaires typically describe professional association development as of unusually high quality, research-based and credible, with good awareness of 'real' students in 'real' classrooms. Such development evidently supports deep and often longstanding professional networking, and conferences at least offer significant personalisation to a teacher's perceived needs: where schools or colleges fund attendance, teachers say these needs are negotiated with management to link with either personal performance management or perceived institutional needs. Although any professional association activity is of itself time-limited, it is clear that a high proportion of respondents engage in such activity over time, often over many years. Further, the mixed participation and highly active, interactive and reflective nature of either day or residential association meetings means that teachers are typically engaged in very active and negotiated learning. The study therefore suggests that engaging in face to face professional association activity offers all the characteristics identified by both Joubert and Sutherland (2008) and by Desimone (2011) of effective professional development for teachers of mathematics. Additionally, study participants make strong claims that they offer the affective development identified by Golding (2016).

Much professional association work is deeply embedded in the classroom:

There are these people whose books I've read and enjoyed and you get a chance to follow that up and say well in reality, what do you do with a class that you've tried all that with and it doesn't work, or you simply don't get a chance to try it? And they have the experience that tells you to go slowly, that every little helps, so you build things up, your own expertise alongside your pupils' ways of mathematical being. But there are also less well known figures, who struggle every day in real classrooms, and you get to share that, and they're inspirational and affirming in a slightly different way. And that feeds directly into your

practice, and the combination means you can support your own students in more reasoned and flexible and constructive ways. (Charles)

The data source limits the information this study can offer about less intense engagement with professional association activity, although some interviewees talk about having been a 'passive' member previously, perhaps having just read the journals and bought and used publications. There is a claim (e.g. from Janet, above) that such activity both supports one's professional identity and offers real benefit to one's practice and so to students, although this claim is made in far less extravagant terms than those about face-to-face activity.

It is not clear how far the claimed benefits could spread. As shown, interviewees suggest many primary or non-specialist Further Education teachers might feel a mathematics-focused residential conferences inappropriate, although it is different for those from a mathematics-rich background, or with mathematics-specific responsibilities. However, association websites show that day conferences with a primary focus are enthusiastically received, and the MA and ATM work together to support primary teachers and develop primary resources. For those working in Further or Community Education, NANAMIC's annual conference, even if only for one day, appears to offer powerful ways to address teachers' knowledge and affective needs.

The study identifies some areas of professional development that teachers feel are better provided elsewhere; nevertheless, the benefits claimed for teachers at these conferences – and for their students – are significant, deep, wide-reaching and long-lasting, including a renewed commitment to retention in the profession. Although there are likely to be stages in a career when a teacher is not in a position to spend three or four days of their holiday at a professional association conference, there is no *a priori* reason why such benefits should not be experienced by far greater numbers, and it is important that perceived threats to participation are addressed. These are not just about funding, but about the value teachers perceive management to give to professional association activity and to their professional development beyond the short term specific needs of their employer. While access to funding is entirely in the hands of individual schools or colleges and professional development is perceived as a threat to the institution rather than a benefit for the wider system, it is difficult to see how this can be resolved.

CONCLUSIONS

Mathematics teachers claim a wide range of benefits from professional association activity, and especially face to face events, much of which they talk about as either exclusive to such activity or most effectively provided by it. They say it gives them deep and wide learning that impacts on their students both through specific pedagogical tools and approaches, and through the refreshment and re-commitment. They claim an affirmation of their professional identity through sharing goals and values with others, and increased self-efficacy through peer validation and personalisation of development. Teachers value the subject-specific nature of professional association activity, that contrasts with much school-based, typically, generic development. They appreciate the range of ideas and ways of thinking that far exceed what is available within one school/college or group of institutions. For many, these claimed benefits have been developed and sustained over years.

Clearly such claims are not straightforwardly generalisable, since the teachers in this study are self-selecting, valuing their own professional development highly, being prepared to give up holiday, and in many cases, fund themselves, in order to do so. However, it would seem clear that many of the claimed benefits are likely to apply to a far greater number of teachers than at present access them, and ways of facilitating such engagement should be sought. The evidence from this study suggests this would be a cost-effective way of

improving the quality of learning in mathematics classrooms and of retaining effective teachers in the system.

This study offers clear evidence to management and policy makers about the value teachers of mathematics place on subject-specific development that affirms their professional identity and their values, recharges and renews their commitment and enthusiasm, and engages them actively in deep and reflective subject and subject pedagogic learning. With current performance pressures and limited budgets, it is not surprising school and college leaders often privilege perceived immediate curriculum needs, but the cost of a professional association conference with no cover requirements is small when compared with the costs to students of a stale and drained teacher – or no teacher at all. Politically-acceptable ways to invest in teachers' longer term subject-specific development should be sought, so that more teachers are enabled to participate in such activity.

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APPENDIX A: INTERVIEW QUESTIONS

1. Tell me about your professional background... and your history of involvement in NAMA/ATM/MA(NANAMIC)
2. What aspects of the conference are you finding particularly helpful (why?)
3. What are the limitations of a conference like this in terms of your PD – what aspects of your PD are better provided elsewhere? (*prompt*: other association activities, online affordances?)
4. And how do all these different opportunities impact on your students? (*prompt*: and their learning? How do you know? Conference-specific impact if not mentioned)
5. So if someone asked you how you stay up to date, maintain your skills, and develop further as a teacher, what would you say?... and has that changed over your career?
6. Any other comments you'd like to make about your PD and its relation to PA activity? Thanks.

APPENDIX B: QUESTIONNAIRE

Your current role:

Your length of teaching experience:

1. How important are the following aspects of the conference to you? (rated 1 to 5 where 5 is 'very important', 1 is 'of little importance')
 - Meeting people in comparable roles
 - Meeting people from other phases in education or with different roles or from different areas of the country
 - Face to face rather than at a distance
 - A mix of beginners and experienced colleagues
 - Sessions that are grounded in the classroom
 - Social activities
 - Immersion – it's residential
 - Opportunity to do mathematics or engage with new ideas, irrespective of whether I'll use them directly in the classroom
 - Being able to choose sessions which fit my needs/preferences

Please add below any particular reasons why any of these particularly matter to you

2. Beyond conferences, what contribution does NAMA/ATM/MA membership make to your professional development (PD)?
3. What are the limitations of the conference in terms of PD: what sorts of needs are better provided in other formats? (you might consider e.g. locally or chain/group-run PD; within-school/college development; online PD; social media)
4. How do the range of professional association and other PD compare in terms of their impact on your students?

If you have any further comments about the impact of professional association activity on you as a teacher, do please email Jennie Golding at j.golding@ucl.ac.uk. Thank you.

APPENDIX C: QUESTIONNAIRE QUESTION 1 RESPONSES

Association (number of responses from conference attendees; variable response rate)	NANAMIC (10)	NAMA (29)	MA (56)	ATM (90)	Overall (185)
Meeting people in comparable roles	3.9	3.7	3.7	4.2	3.9
Face to face rather than at a distance	4.2	4.5	3.9	4.3	4.2
Meeting people from other phases in education or with different roles or from different areas of the country	3.8	3.9	3.9	4.7	4.2
A mix of beginners and experienced colleagues	3.7	4.0	3.8	4.6	4.2
Sessions that are grounded in the classroom	4.1	3.4	3.7	4.2	3.9
Social activities	1.8	2.3	2.2	3.9	3.0
Immersion – it’s residential	n/a	2.3	3.2	4.3	3.6
Opportunity to do mathematics or engage with new ideas, irrespective of whether I’ll use them directly in the classroom	3.8	4.5	4.3	4.6	4.5
Being able to choose sessions which fit my needs/preferences	4.1	3.7	4.2	4.7	4.4

APPENDIX D: INTERVIEWEES

Name	Source*	Current role	Teaching background	PA background
Alice	ATM	Secondary SEN mathematics teacher	20 years secondary and special schools	Member 6 years, 6 conferences, now PA leadership group
Lara	ATM	Secondary mathematics teacher	Secondary 8 years (career changer)	Member 8 years, 2 nd conference
Terry	ATM	Secondary mathematics teacher	Secondary 7 years (career changer)	Member 2 years, 3 rd conference
Billy	ATM	Independent consultant	12 years secondary then local adviser then ITE	Member many years, many conferences, has been on PA leadership group, writes for periodicals.

Jackie	MA	HE Mathematics Education including Primary, Secondary and FE ITE	10 years Primary, 25 years Secondary and FE Mathematics teaching	41 years including involvement in leadership and sub-committees. Many conferences. Has been active in local branch.
Janet	MA	Primary/Secondary Mathematics adviser	Primary 17 years, secondary 10 years	Member 35 years, 3 rd conference, now on PA sub-committee
Kim	MA	5-18 mathematics teacher	Secondary 7 years (career changer)	Member 3 years, 2 conferences. Active in local branch.
Rachel	MA	Primary teacher/p-t adviser	20 years Primary teacher	Member 10 years, 2 nd conference
Charles	NAMA	HE Mathematics Education including Secondary ITE	12 years Secondary Mathematics teacher	Member 16 years, active in local branch, writes for periodicals.
Gail	NAMA	Primary teacher education (mathematics)	10 years Primary teaching	Member 20 years, 1 st conference
Graham	NAMA	Independent consultant	Secondary teaching 10 years then LA consultant	Member 20 years, 10+ conferences, active in local branch
Kathy	NAMA	Secondary Assistant Headteacher	8 years secondary teaching, local adviser 4 years, back into secondary teaching for 4 years. Career changer.	Member 16 years, 6 th conference. Active in local branch when she can.
Sally	NANAMIC	5 years as independent consultant	Trained and 8 years in secondary; 20 years in FE including as subject manager. 5 years in national CPD body	Member 'many' years, including substantial time in a national executive role. 'Many' conferences.
David	NANAMIC	Adult and community education – mathematics (8 years).	Secondary teaching in several 11-18 schools then a PRU.	Conference was first contact with professional association ('not a joiner').
Angela	NANAMIC	FE lecturer (largely A Level, some level 1 and 2 courses)	FE teaching for 15 years	Regular at conferences; some wider involvement nationally, including with policy and ISIS/ETF initiatives.
Susan	NANAMIC	Has just left FE.	Secondary teaching 12 years, then FE 4 years	Many conferences.

*Some interviewees are active in more than one professional association; this column merely notes the conference source of their interview