NCSL National College for School Leadership

www.ncsl.org.uk

Think piece

What are we
learning about...?

'Making mathematics count' in school networks

> *Learning networks are one of the powerful ways to improve pupil learning and attainment in mathematics. They provide a unique resource for developing the professional aspirations of all teachers of mathematics.*
>
> Celia Hoyles

Networked Learning Communities

learning from each other | learning with each other | learning on behalf of each other

Acknowledgements

We would like to thank all of the authors for their time, patience and commitment to this publication.

We would also like to thank Stefan Bodo, Karen Carter, Tim Coulson, Kerryanne Delbridge, Robert Hardy, Celia Holyes, Gene Payne and Melissa Murphy.

Nick Martin and Non Worrall
Lead Developers

'Making mathematics count' in school networks

Across the country, teachers of mathematics have been teaching, enquiring and learning together. By creating subject-specific learning networks, they are finding ways to solve some of the problems that currently face the profession. More importantly, they are improving the learning experiences of children in classrooms and schools, and in a diverse range of contexts nationwide.

By improving pedagogy through 'doing mathematics together', learning networks of teachers are making a real difference to children's day-to-day experiences of mathematics. Whilst teachers are benefiting from working with others in networks by developing innovative practices and trying out new ideas, children are experiencing new and exciting approaches to the curriculum and improvements to their learning environment.

Planning and teaching lessons together, finding innovative ways of approaching areas such as 'ratio' or 'simultaneous equations' and exploring new technologies such as interactive white boards – all contribute to making a difference. Networked activity stimulates innovation. At the same time, teachers exert upon each other the discipline of having to provide for their peers the evidence-base for the action and impact of the innovation. In this way, professional accountability is built into the process of implementing in classrooms what has been shown to work in practice.

Many reports, from the Cockcroft Report (1982) to Professor Adrian Smith's report *Making Mathematics Count* (2004), have identified key issues faced by both teachers and the education system as a whole, in the pursuit of effective teaching and learning of mathematics. By being creative in their approach to the curriculum and by creating new forms of continuing professional development, networks are beginning to address many of these issues. This is good news for children, as these are the very challenges that have been identified as restricting further progress in moving forward teaching and learning in mathematics at both the classroom and the system levels.

In this short paper, we outline what we have found to be the characteristics of effective school learning networks and describe what they look like in practice. We also look at how, through this practice, networks of teachers are helping to address three key issues associated with effective teaching and learning in mathematics.

Three characteristics of network practice for effective teaching and learning in mathematics

1. **Doing mathematics together in networks** to enhance specialist subject knowledge and increase the supply of confident teachers of mathematics.
2. **Planning and working together in networks** to ensure that the current and developing mathematics curriculum, assessment and qualifications framework meets the needs of all learners.
3. **Problem-solving and learning together in networks** to provide the infrastructure required to support mathematics teachers effectively, particularly in terms of their continuing professional development.

In presenting the case for *Making mathematics count in school networks* we draw directly upon the learning and experience of NCSL's Networked Learning Communities programme and other network initiatives in the UK and internationally. We hope that this think piece will be of use to you if you are considering setting up a network, are part of a newly formed or established network, or if you are simply interested in finding out more about making mathematics count in school networks for the benefit of both teachers and children. □

What happens in an effective network?

When you decide to set up a network of mathematics teachers there are a number of things that you will need to take into account. From the experience of teachers already benefiting from working together in learning networks, and from research findings, it is possible to identify factors that successful networks have in common. Considering these factors may help to inform new network design and development, ensuring that schools can build from what is known.

In *What are we learning about...? Establishing a network of schools* (NCSL, 2005) we identified the following four areas of activity as characteristic of what happens in effective learning networks.

1 Design around a compelling idea

Successful learning networks are those that manage to unite everyone around a learning purpose that is relevant and compelling, whatever the school contexts or current circumstances. For example, this might include: looking at the progression of written calculations across all phases; providing a network programme of study and peer mentoring scheme for gifted and talented pupils; or exploring strategies for improving pupils' problem-solving skills by teaching them to approach a problem logically, to consider all the possibilities and look for patterns.

However diverse the schools in a network, it is safe to assume that all of the adults want to improve the pupil experience and that is why they have committed to the network. Teachers will want to engage with new ideas if they can see a direct benefit for their pupils and networks increase access to good ideas.

The following practical strategies are helpful in developing wide appeal and involvement in a network:

- ensuring that the initial propositions of networked learning are framed around children's needs
- setting up school-to-school enquiry or network activity groups involving a broad range of staff from different schools
- organising school-to-school visits so that learning transfers easily and rapidly between schools
- ensuring that network structures do not exclude some schools because of their timings or locations
- involving pupils in meetings and other activities

2 Create new forms of adult learning

We know that when teachers are engaged in collaborative enquiry into practices, processes and outcomes with teachers from other schools, they are more likely to improve their own analytical thinking and are more prepared to take risks. It is an opportunity, then, to 'work smarter together, not harder alone'. It also provides a context for generating together network-wide knowledge that can have a direct impact on the children in classrooms across all the network's schools.

The following characteristics tend to be found where collaborative enquiry takes place in a network:

- using a facilitator to plan and lead sessions
- making best use of each other's practice by visiting each other's schools and classrooms
- enquiring into the challenge areas for the network
- taking on the evaluation role for the network and generating evidence of impact
- visiting other networks and generating 'accounts of practice' for discussion by all

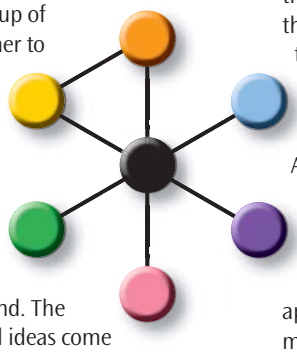
3 Have dedicated leadership and management

The leadership, internal facilitation and management of your network will be crucial to its development. Research has shown that the success of a network (particularly in its early stages) is almost uniquely dependent on the vision, energy and effort of those who take on the leadership role. The leadership of a network will sort and shape the activity, guiding reflection and adaptation and helping to re-focus activity to make sure that it remains purposeful.

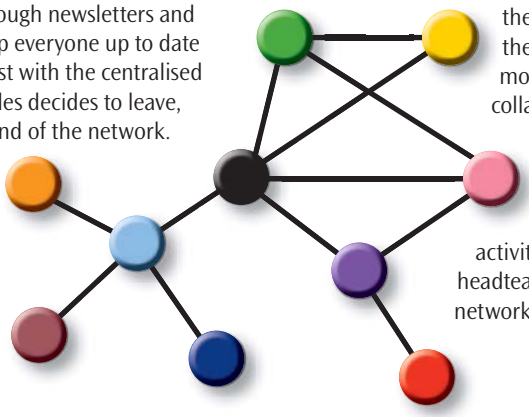
We know, both from the experience of networked learning communities and of other networking and collaborative initiatives, that a variety of people play a leading role in networks. These leaders, if they are to co-ordinate a group of teachers for any period of time, will require the support of the network's headteachers and other senior leaders. Successful networks know that leadership within the network will not necessarily come from the traditional places. They find systems that distribute it throughout. In this way they ensure that all adults within the network are able to take responsibility for creating, validating and spreading knowledge about what works.

4 Develop appropriate forms and structures

In a **centralised network**, the control is predominantly centred around the hub. All network activity and communication goes through the centre. For example, one of the **Learning to Learn mathematics networks,** in Southampton, consists of a group of secondary schools working together to develop lesson plans, resources and interactive online activities linked to the KS3 unit plans, which they share via a virtual learning environment. The group is led by one of the schools' heads of department, with a local authority mathematics advisor acting as their critical friend. The advantage of this model is that all ideas come through the hub and can move quickly across the network. However, it does rely heavily on the centre, and if the hub leaves the network and is not replaced, then the network will collapse.

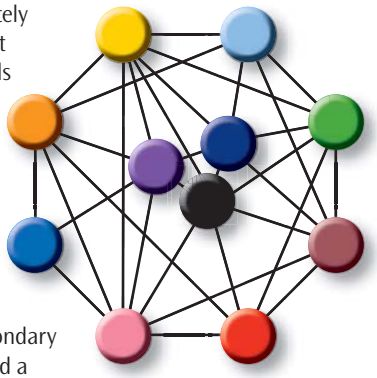


In a **de-centralised network** model there is far less control from the centre. The leadership is dispersed across the network, with several people taking the lead at any one time. Individual nodes can communicate and collaborate with each other, independent of the hubs. The **Small Schools Managing Improvement Group** exemplifies this model, with a network of teaching assistants, SENCOs and headteachers co-developing a programme of support for those pupils who just miss out on SEN status. The group is co-led by the headteachers. The advantage of this model is that individuals are free to work together in smaller groups and there is no requirement that they should involve everyone in everything they do. The disadvantage is that knowledge transfer can sometimes be haphazard. The network has addressed this issue through newsletters and regular meetings to keep everyone up to date with progress. In contrast with the centralised model, if one of the nodes decides to leave, this does not spell the end of the network. However, if new links are not formed and new leaders do not take their place, the network may disband and form several smaller networks.



The most advanced form of networking is for every node to be connected to every other node to create **multi-centred and multi-connected networks**. This ensures that knowledge and new ideas, wherever they begin, travel quickly across the network. Any node is free to collaborate with any other node, and leadership is distributed across the network. In this model there can be many hubs, and the role of the centre is to facilitate the network, rather than control it. If any of the leaders should leave, the network will reconfigure itself and new leaders will take their place.

A network that comes close to this model is the *thinking maths groups*, part of the **Bedfordshire Schools Improvement Partnership**. This is a cross-phase group of approximately 30 teachers looking at applying a thinking skills methodology to teaching and learning in mathematics. They share their ideas with other teachers in the county through the local authority website. The group is co-led by an AST, a secondary head of department and a middle school leading mathematics teacher. They also have two critical friends, a KS3 numeracy consultant and a facilitator from the wider network.



At the start of each academic year they draw up a timetable of half-termly sessions. The mornings are active continuing professional development (CPD) sessions involving all members of the network, with different people leading on different topics at each session. The topics are identified by the needs and interests of the network members and relate directly to what they are doing in their classrooms. During the afternoon the co-leaders reflect on the morning's progress and then plan the next collaborative session. Each school in the network, convinced of the value and impact of its work, has committed the necessary time and human resources to the network's activity. Without this commitment from headteachers and other senior leaders the network would not function effectively. □

The characteristics of network practice

1 *Doing mathematics together in networks to enhance specialist subject knowledge and increase the supply of confident teachers of mathematics*

In many schools there are teachers of mathematics who are not subject specialists. In secondary schools this includes those who are not trained to teach secondary maths but are often called upon to fill gaps in the timetable - perhaps because they have an 'A' level in mathematics. Equally, there are primary teachers who would appreciate support in developing their subject knowledge and skills in extending pupils' learning in the more challenging areas of the National Numeracy Strategy.

At the same time, there are also many experienced mathematics teachers who routinely reflect on their own practice and are constantly looking for new and innovative ways of teaching mathematics. The teaching experience and expert subject knowledge which these teachers have makes them well placed to work in support of their colleagues.

Learning networks can combine these groups and have repeatedly demonstrated that they can help practitioners to become more confident at teaching mathematics by providing support, ideas and resources. By extending teachers' knowledge of the subject and encouraging them to take risks, learning networks of mathematics teachers are tackling this issue by 'doing mathematics together'.

For many inexperienced and non-specialist teachers it can be very difficult to disclose to peers, within their own school, that they don't fully understand something that they are teaching. A school-to-school network can provide a safe and secure environment where teachers can share their concerns and come up with solutions together. This type of activity builds confidence, which ultimately leads to more effective teaching and learning.

Having the time and space, in a safe environment, to explore the intricacies of areas of the curriculum in which teachers lack confidence to teach effectively, can be both rewarding and beneficial. The regularity of peer discussion and review also provides an added incentive for action. In other words, good collaborative planning, problem-solving and enquiry in networks is proving to be especially helpful in growing and spreading mathematics expertise.

2 *Planning and working together in networks to ensure that the current and developing curriculum, assessment and qualifications framework meets the needs of all learners*

Who better to develop these areas than networks of practising teachers and the pupils themselves, in partnership with bodies such as the Qualifications and Curriculum Authority (QCA) and the National Assessment Authority (NAA)? Learning networks of mathematics teachers are responding to curriculum issues by creating more extended and exciting cross-curricular learning opportunities to replace an outmoded reliance on textbook exercises. For example, in many primary schools, children are encouraged to grasp the relevance and importance of mathematics through a thematic curriculum, where the daily numeracy hour merges seamlessly into a week spent looking at a related theme. Numerous secondary schools have similarly found that data handling can be more effectively delivered through cross-curricular projects with humanities, science and English departments.

❝ By working together differently the goal is to produce quality ideas and practice on an ongoing basis, and to inspire collective effort to the extent that it becomes effort to achieve breakthroughs never before experienced. ❞

Michael Fullan, 2004

Joint planning and collaborative work generates a sense of collective ownership that enables all members of the network to take those risks which characterise innovation. As David Hargreaves (2004) points out; *"All innovation involves taking risks. There is no such thing as risk-free innovation."* The issue of trust, and teachers feeling confident to take risks, is key to generating innovative practice. When people form collaborative professional work groups they will take risks together that they would not take alone.

❝ I think working with maths teachers from other schools gave me the courage and support to explore new strategies for getting girls to take more risks in problem-solving. ❞

Network mathematics teacher

The process of creating something new together is energising. It builds relationships within the group and helps to generate trust amongst its members. Once a group has developed a sense of collective identity, members begin to feel safe in that group.

One example of working together is collaborative enquiry. This is a particularly effective way of working because it places the teacher in the role of the learner, willing to embrace the perspectives of others. Teachers who have worked on collaborative enquiries become part of that ethos, constantly striving to share data about practice and their new knowledge with others, both in their own schools and beyond.

In the experience of networked learning communities, the following enquiry approaches have proved to be helpful in creating a context for working together on curriculum, assessment, or pupil learning issues.

- Research lessons (eg 'How can we teach ratio better in KS3?'.)
- Networked learning walks (eg focused on improving the teaching and learning of division in Year 3.)
- Action enquiry (eg investigating the use of interactive whiteboards to teach primary mathematics.)
- Collaborative enquiry (eg into the benefits of using graphic calculators in Year 12.)

In contrast to a pedagogy-focused group such as 'assessment for learning', teachers from a specific subject area like mathematics identify particular benefits of a school-to-school network. Network members talk of working with 'like-minded individuals' – people who have a desire to improve their subject-specific practice together, and who have a genuine interest to learn more about the nature of mathematics itself.

The characteristics of network practice

3 *Problem-solving and learning together in networks to provide the infrastructure required to support mathematics teachers effectively, particularly in terms of their continuing professional development*

In addressing this complex issue, the DfES (2004) identifies learning networks of practitioners as a possible solution because they re-energise, develop and inspire teachers, but also make a real difference to the learning experiences of children.

As David Hargreaves (2004) describes: "*Transfer between departments within a school may be more difficult than transfer between teachers of the same subject in different schools.*" An important question here is how to build further on the sharing of expertise that already exists in schools, in order to create a robust infrastructure of support for the continuing professional development (CPD) of mathematics teachers. What might such a CPD infrastructure look like if it were to accommodate a continuous and personalised form of professional learning designed to meet the specific needs of the network *and* the maths teachers themselves?

The answer is that learning and problem-solving together, which are key features of successful networks, also provide opportunities for practitioners to develop their own solutions to problems specific to their context. At the same time, it is possible for networks to create a collaborative context for meeting individual training and development needs.

"Being part of this network is the best professional development I have ever had. It really makes you think about your own practice and it's the first time, that I can remember, that I have sat down with other teachers, talked about teaching and learning, and actually done some mathematics together."

Network mathematics teacher

People need to feel safe before they will explore their practice or share their problems with their peer group. Only then can they begin to find context-specific solutions to their problems together, as the social capital is increased. A safe environment is key to joint problem-solving. A non-threatening group of like-minded colleagues can enable every member of the group to articulate challenges which may be difficult to share in the home environment. Being able to discuss the problem becomes the first step in being able to solve it.

Being part of a network gives mathematics teachers access to new forms of professional development. In the place of attending off-site, one-off INSET sessions run by an 'expert', networked CPD offers facilitated learning opportunities that give equal weighting to the expertise that already exists within the group and the learning that can be gained from outside sources.

Networks encourage the development of peer relationships which stimulate the growth of mentoring and coaching partnerships, thereby building the organisational capacity of the member schools. These types of relationships are important because one feature of knowledge transfer is related to how tacit or implicit it is. By problem-solving and learning together, maths teachers can develop ways of discussing their practice and techniques which makes their knowledge explicit and, therefore, more easily transferable. □

End piece

“ Subject networks will spearhead the personalisation of those aspects of teaching and learning that count in the daily experience of students in their learning. ”

David Hargreaves, 2004

In contrast with individual schools, it is commonplace for mathematics teachers in networks to do mathematics together. For specialist maths teachers, considering together questions such as ‘what is the value of 0^0?’ or ‘is a rectangle a trapezium?’ is a stimulating challenge in itself but, more importantly, it places the teacher in the position of the learner.

Following on from the report *Making Mathematics Count* (Smith, 2004) the DfES has proposed that one of the roles of the National Centre for Excellence in the Teaching of Mathematics should be “*to foster independent mathematics initiatives, which can contribute to school mathematics networks*”. This is a significant acknowledgement of the potentially powerful role which networks can play in taking forward developments in the teaching and learning of mathematics at both classroom and school levels towards system change. The practice of networks within the NLC programme and beyond has shown that it is possible to tackle some of the identified issues which in the past have restricted progress towards this goal.

By ‘doing mathematics together’ in networks, by studying each other’s practice through collaborative planning and problem-solving, teachers of mathematics have pointed to the tangible benefits for both teachers and children when they are able to come together, to work and learn together within a networked support structure. In so doing, they have demonstrated how it is possible to make mathematics count in networks.

The experience of these learning networks has shown that, by adopting network practices, it is possible to create the necessary resources and provide the infrastructure for a sustained culture to support continuing professional development and nurture all teachers of mathematics. As learning networks begin to adopt strategies to meet local needs and solve local problems, whilst at the same time addressing national requirements, a system-wide change could be on the horizon. In this regard, the achievements and experiences of network practitioners so far, provide an indication of what the future might hold. □

References

Cockcroft, W H, 1982, *Mathematics Counts; Report of the committee of inquiry into the teaching of mathematics in schools,* London, Her Majesty's Stationery Office

Department for Education and Skills, 2004, *Effective Networks*, London, DfES

Fullan, M, 2004, *Systems Thinkers in Action: moving beyond the standards plateau,* London, DfES

Hargreaves, D, 2004, *Personalising learning: next steps in working laterally*, London, Specialist Schools Trust

National College for School Leadership, 2005, *What are we learning about...? Establishing a network of schools,* Cranfield, NCSL

Smith, A, 2004, *Making Mathematics Count*, London Department for Education and Skills

What are we **learning about...?**

The 'What are we learning about…?' series is designed to make public the learning that has emerged from NLCs in the last two years.

The first nine titles in the series will focus on:
What are we learning about…?

- LEA involvement in school networks
- Establishing a network of schools
- Community leadership in networks
- ***'Making mathematics count'* in school networks**
- The impact of school networks
- Sustaining a network of schools
- Facilitation within school networks
- Professional development in school networks
- Leadership of school networks

To order a copy of this publication and others in this series, please email **nlc@ncsl.org.uk** quoting the reference **WAWLA/Making mathematics count**

National College for School Leadership
Networked Learning Group
Derwent House
Cranfield University Technology Park
University Way, Cranfield
Bedfordshire
MK43 0AZ

T: 08707 870 370
F: 0115 872 2401
E: nlc@ncsl.org.uk
W: www.ncsl.org.uk/nlc

NCSL National College for School Leadership