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Minding Gaps in Argument

Continuing Professional Development to Support the Teaching of Scientific Inquiry

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2009

University of BRISTOL

SEVENTH FRAMEWORK PROGRAMME

mind the GAP

Acknowledgments

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Contents

Introduction

This booklet summarises the activities of a continuing professional development (CPD) programme that was implemented as part of the *"Mind the Gap: Bridging Policy, Research and Practice"* project funded by the European Union. The programme was implemented in 2008-2009 with 6 secondary science teachers from 4 schools near Bristol, England in collaboration with researchers from University of Bristol.

The aim of this programme was to begin a conversation with teachers about issues related to some gaps that exist between educational policy, research and practice. The particular area for exploring such gaps was scientific inquiry and in particular the notion of "argumentation" – the coordination of evidence and theory in science. In England. such themes have become increasingly visible through the "How Science Works" component of the national science curriculum (DfES/QCA, 2006). Hence the key goals of the project were:

- to develop a CPD agenda on a relatively new aspect of the curriculum in order to bridge the policy-practice gaps;
- to draw from existing research literature to contextualise the role of argumentation in science and in science education;
- to generate some example student resources that can be useful for other teachers;
- to explore exemplars of the implementation of "How Science Works" and argumentation activities in science classrooms;
- to investigate the impact of the CPD agenda on the teachers' professional development.

The document will highlight some of the strategies that we have used in order to achieve these goals. The booklet contains a description of the CPD model; the activities conducted between the teachers and the researchers; some example lesson resources accompanied by some video footage to provide context for the use of these resources and a set of video clips that illustrate the various aspects of the CPD and the impact of CPD on the teachers.

Professional Development Agenda

Argumentation has been advocated in curriculum policies (e.g. DfES/QCA, 2006) and assessment frameworks (OECD, 2003) around the world. There is also now ample rationale and research evidence on strategies that promote argumentation at the level of the classroom (Erduran & Jimenez-Aleixandre, 2008). Argumentation involves the processes of coordinating evidence with theories in science, and constitutes a significant aspect of scientific inquiry.

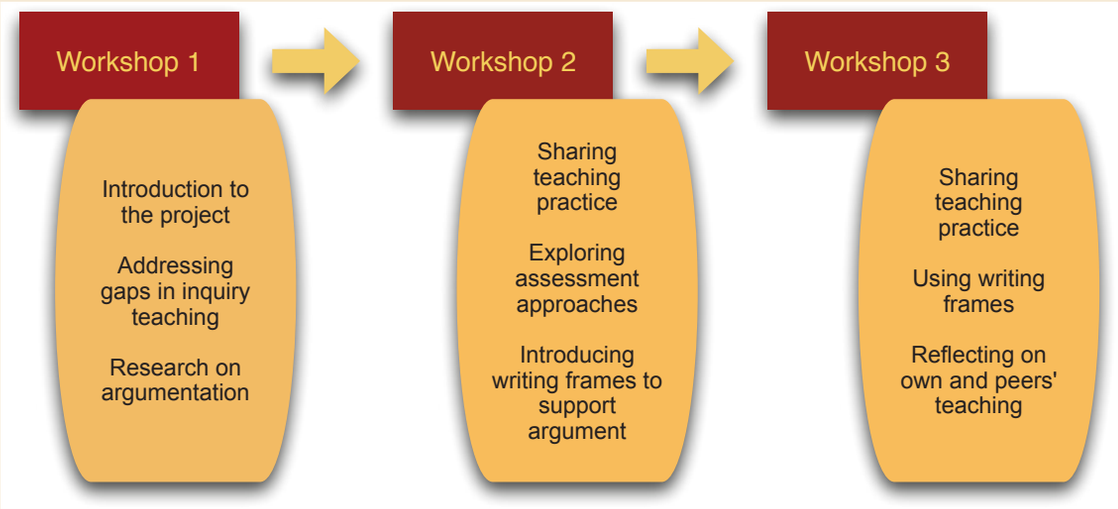
Whilst policy and research recommendations unite in promoting argumentation in science classrooms, significant gaps remain between educational policy, research and practice in the context of inquiry teaching and in argumentation in particular. For example, the professional development of science teachers in argumentation is rare (Zohar, 2008). In this project, we aimed to bridge gaps between research on argumentation, the curricular context in England and professional development of secondary science teachers.

In terms of professional development, there is substantial body of research literature on professional development of science teachers. According to Supovitz and Turner (2000) a high-quality professional development programme should have the following features:

- immerse participants in inquiry, questioning and experimentation;
- be intensive and sustained;
- engage teachers in concrete teaching tasks and be based on teachers' experiences with students;
- focus on subject-matter knowledge and deepen teachers' content skills;
- be grounded in a common set of professional development standards and show teachers how to connect their work to specific standards; and
- be connected to other aspects of school change.

Whilst it was not possible to implement all features of this model (e.g. conection to other aspects of school change), our work in this project were guided by the principles of teachers' collaborative exchanges with peers and reflective inquiries into their own teaching. The teachers were recruited by writing to schools about potential involvement in the project and the participating teachers volunteered to be join. They were primarily mid-career teachers who specialised in chemistry and physics.

Each workshop had input (a) by researchers, in terms of evidence from research evidence on the teaching of argument, and (b) by teachers, in terms of classroom learning and teaching practices. Variety of activities and formats were employed including group discussions and presentations. The professional development aspects of the project are summarised in the DVD in Clips 1-6. The clips range in how the teachers addressed the curriculum policy context to the strategies used to support professional development such as evaluating and reflecting on peer teaching.



In each workshop, a different theme framed the conversations. The first workshop made an explicit effort to engage the participants in a discussion of gaps between research, policy and practice in inquiry-based science teaching. In this workshop, some research and lesson resources were introduced. Between the first and second workshops, the teachers designed and implemented some inquiry-based lessons emphasising argumentation. In the second workshop, they shared these experiences and the researchers had further input in the areas of assessment and writing of argument. The third and final workshops further built on the sharing of teaching experiences and provided space for reflection.

Throughout the workshops, the teachers were encouraged to identify the issues and problems stemming from their practice and to choose the topics that they were interested in exploring in their teaching practice. The researchers' role was defined as that of 'critical friends' and 'facilitators', in accessing research evidence and resources for teaching. During the 3-4 month span between the workshops, teachers videotaped their lessons where parental consent could be obtained. Some of these videos were shared during the workshops. In some cases, teachers from the same school videotaped each other and collaborated in the identification of resources and teaching strategies.

Workshop 1

30 minutes	Introductions & project overview
30 minutes	Group task on identifying the 'gaps' regarding teaching and learning of HSW
30 minutes	Group discussion of Experiences of "How Science Works"
15 minutes	Presenting own views of HSW
30 minutes	Researchers' input on aligning 'argument' in policy, research & practice
60 minutes	Share lesson ideas and begin planning

The first workshop introduced the aims and objectives of the project, and started a discussion on "How Science Works" (HSW) component of the national science curriculum in England. An example of this discussion is provided in **Clip 1** in the DVD. Teachers shared their experiences with the new curriculum. For the most part, there had been no systematic exposure to HSW and scarcely any professional development activities. Teachers were invited to identify the gaps of teaching HSW in practice and address the issues that they are interested in pursuing for the duration of the project (**Clip 2**). The researchers had input into this workshop by highlighting a model of argument based on Stephen Toulmin's work (Toulmin, 1958) that was visited repeatedly throughout all the workshops (**Clips 4 and 5**).

Featured Outcomes

Teachers' references to gaps across policy, research and practice

In the group task of identifying the 'gaps' regarding teaching and learning of HSW, teachers used a writing frame to prioritise gaps across research, policy and teaching. The following are some of the ideas that emerged from this discussion.

Gaps between teaching goals and teaching methods in HSW

The teachers agreed that HSW concerns the nature of science and is about processes and explanations in science rather than facts. However, they indicated that they faced the challenge of inquiry-based teaching methods in practice. For example, when using problem-solving methods, they expressed that they face the dilemma of students not being interested in teachers' approaches to teaching HSW and that some students could initiate ideas that "could lead to no-where [irrelevant to teaching goal]" or not "testable and practical in class." Clip 2 in the project DVD provides an example of this discussion where the teachers are addressing the challenges faced in teaching HSW.

Gaps between policy of HSW and the schooling

Although HSW has been incorporated into the national curriculum for England and Wales, other aspects of schooling have not been changed accordingly. As showed in Clip 1, one of the teachers mentions the gap between HSW and other contents in the curriculum. Furthermore, the regulations of the schooling system are not deemed to be consistent with HSW. For instance, the teachers indicated that lesson times are not appropriate for effective teaching of inquiry, and that the assessment tools typically used do not encourage the teaching and learning of HSW.

Gaps between policy initiatives and teachers' in-service professional development

Although the teachers are required to teach HSW, most did not go through any in-service teacher training. When professional development was provided, the teachers felt that the training is more like a 'tick-box' activity where the justification of curricular changes and practical support for teaching are not provided.

Gaps between social influences and science teaching goals

The teachers emphasised that the stereotype of science and scientists influence the students' view of the nature of science. Anti-science and anti-scientists' views could discourage the students' motivation and attitudes to learning of science. Teachers agreed that "it [HSW] raised the question of 'what is science' to the public", as "the end result of science is too visible while the process is invisible."

Gaps in cultures of marginalised groups

The teachers highlighted the case of students with strong religious beliefs and how these beliefs could present difficulties in engaging in the nature of science and scientific inquiry. The students could also find the language and terminology of science are in their way to understand and express the scientific ideas. Some of the students' deficiency of their mathematics knowledge could also impede their understanding of science as HSW requires high skills of literacy and mathematics, which could marginalise those students with limited literacy and numeracy skills.

Workshop 2

90 minutes	Sharing resources in the group
90 minutes	Exploring assessment criteria for HSW & argument
90 minutes	Researchers' input on measuring quality of argument
60 minutes	Group planning for the next phase
30 minutes	Review of activites so far

At the second workshop the teachers presented the recourses such as teaching strategies and lesson materials that they had produced after the first workshop (Clip 3). They reflected on their own as well as their peers' teaching. According to the "gaps" identified by the teachers in the first workshop, the assessment issue has been addressed particularly in the second workshop. One of the key input by researchers into this session concerned assessment where the group was tasked to search the internet to locate the national criteria for assessment of "How Science Works". Subsequently, the group discussion centred around the connection between teaching and learning of scientific inquiry and the impact of assessment (Clip 6). The theoretical model of argument based on Toulmin was repeated in the discussion, this time with an eye towards how it can be transformed for purposes of assessment. Furthermore, some ideas of measuring the quality of argumentation in terms of the use of rebuttals (Erduran et al., 2004) was included as an extension of Toulmin's work from the first session.

Featured Outcomes

Resources

Clip 7 illustrates one example of the resources that were produced by teachers. In **Clip 7**: Steve's Runny Honey Lesson, a practical lesson with Year 9 students on exploring the viscosity of the honey is summarised. This includes (a) How Steve introducing the aim of the lesson with a real-life context based on the use of oils in engines as lubricants, and a demonstration through a model; (b) students planning and carrying out various inquiries in order to address how viscosity is affected by temperature; (c) Steve reflecting on his choices in the lesson.

Suggestions and examples offered by teachers included:

- Visualise the "abstract" ideas and concepts of HSW
  e.g. Steve's use of graphs to compare students' data
- Emphasise HSW in experiments
  e.g. Grace on drawing conclusion based on students' own results
- Set goals for the group discussions on specific tasks
  e.g. In tasks, students need to be positioned to question, review and evaluate evidence in order to draw a conclusion
- Set up situations for students to realise the importance of HSW practices
  e.g Davina's lesson where students are encouraged to keep record of the experiments.

Overall, some ideas were summarised for supporting the teaching and learning of HSW:

- Set in context or with real-life application
- Simplicity in understanding the content
- Authentic problems with no obvious "right" answers
- Interesting topics from students' point of view

Reflections on own and peers' teaching

The teachers engaged in reflective comments on each other's practice and resources. The discussion reinforced awareness of the more gaps in teaching and learning of HSW. For example, the lack of appropriate resources in teaching HSW. Furthermore, teachers made some references to problems with existing resources:

- Not targeted for the appropriate student audience (e.g. proper literacy level)
- Not focused on specific subject (e.g. chemistry)

Assessment tools

Teachers indicated that current assessment methods tends to give the marks to "end point" rather than "process" of science, which is contradictory to the HSW agenda. As part of an exercise on developing assessment criteria, they reviewed science attainment levels outlined by the Qualifications and Curriculum Authority in England. However, the statements were deemed to be too abstract to apply in practice. Subsequently the teachers used the internet to look up any potential resources on assessing HSW and argument. They found several different tools, for instance: **http://www.webucate.org/ourgallery/thumbnails.php?album=60**

They discussed the online resources including how each resource could or could not address a particular phase of HSW (**Clip 6**). The teachers have also raised the issues of different aspects of assessment, for example, the question like how to differentiate between high and low achieving students. They argued that HSW and argumentation require higher order thinking skills, which implied that HSW is not accessible to or be inclusive of the low ability students, thereby making it difficult to differentiate the lower ability students.

Workshop 3

90 minutes	Sharing resources and group discussion
15 minutes	Supporting writing argument
60 minutes	Mapping written argument framework in pairs
45 minutes	Review of the gaps
30 minutes	Discussion on the products and plans
60 minutes	Individual conversations
30 minutes	Summation

At the third workshop, teachers shared the resources produced after the second workshop, followed by the group discussions and reflection as before. The teachers were also asked to apply the models and examples of teaching argumentation covered in previous workshops to their practice.

They reflected on the help and challenges of using these products from the academic research in the classroom practice. A particular emphasis in this workshop was to reapply the writing frame based on Toulmin's framework. The discussion around this activity exposed some issues related to the relationship between science subject knowledge and argumentation skills (**Clip 5**).

The last part of the workshop was dedicated to produce the criteria of selection, evaluation and presentation of evidence from their classroom practice, resource and group discussion that demonstrated the implementation of scientific inquiry in class.

A new teacher (**Clip 13**) also attended the last workshop having been recruited by colleagues in the same school. The project was concluded with individual conversations to reflect on the whole project (**Clips 9-13**).

Featured Outcomes

Teacher	Resource	Content	Comments from peers
Steve	Runny Honey experiment	Pupils asked to design and carry out the experiments, and then evaluate their own design as well as results.	Positive to put context into the investigation; Justification for the lesson clearly explained in the demonstration;
Grace	Data evaluation lesson	Pupils used spreadsheets to observe trends in data	Visualising the data range to makes it easier and more explicit for the pupils; The spreadsheet shows the instant effects of the data processing
Alex	Resources pack with a range of resources	Some resources were borrowed from existing textbooks and other sources	Range of topics and the connection to other parts of the content in the curriculum
Catherine	Starters	Starter questions to instill in pupils' understanding of variables	Variables put in context Short time required with specific focus on each topic

Relationship between science subject knowledge and argumentation

Teachers used the writing frame to apply to a topic of interest to build an argument. They explored the use of counter-arguments in practice, and raised issues about the application of the writing frame in class as well as possible adaptations and improvements (**Clip 5**). The exercise illustrated some of the difficulties in the construction of an argument when there is limited subject knowledge. Furthermore, teachers indicated that they realised a good question or claim is difficult to pose.

The teachers have been asked to comment on this professional development programme and the trainers tried to explore what their needs are in professional development towards the argumentation.

Impact on teachers

Teachers indicated a range of ways in which the project has facilitated their professional development (Clips 9-13).

Exchange and communication

One of the teachers remarked :

> *" Teaching to some extent, is quite a lonely journey".*

The teachers appreciated the opportunity to exchange experiences and communicate with the teachers across different schools with different experiences and backgrounds. Furthermore, the friendly environment in the workshops encouraged the participants to critically and reflectively comment on each other's work.

Ownership and engagement

The participants enjoyed this teacher-oriented programme that focused on their interests or issues. They felt supported to explore their interests in their own teaching situations. The sense of "ownership" motivated them to take on the initiatives. As one of the teacher said:

> *"This open project allows us to do what we are interested in."*

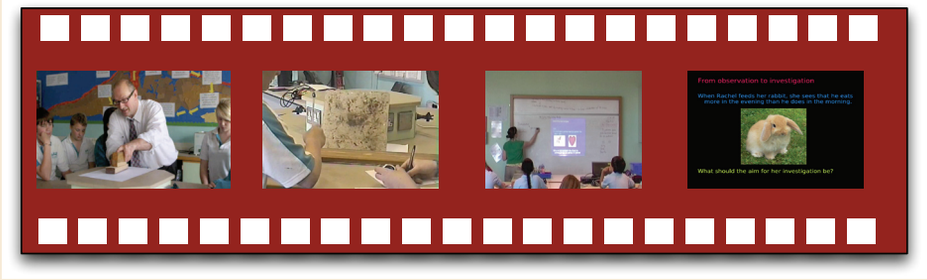
Impact on teaching argumentation

Except for one teacher who joined the project in the last session only, all of the rest of the teachers attended the workshops and taught in between the workshops. Thus, teachers have been asked to reflect on the impact on their teaching practice and development.

- **Clarification and justification of curricular policy**

The teachers appreciated this programme for clarifying the justification of the policy initiative from the trainer's introduction and guided peer discussions. As one teacher said

> *"if teachers only see HSW as one of the policy changes in the curriculum, they won't bother to think seriously about it, never mentioned to take on initiative to teach differently in the class."*



During the workshops, the teachers had a better idea about the reason why HSW was introduced to the curriculum and what would be the benefits of teaching and learning of science via argumentation. Through the exploration of the gaps between the policy and teaching practice, the teachers' awareness of the issues was raised. They indicated that their understanding of the HSW and argumentation has also been improved through the dynamic discussions in the workshops. Furthermore, the teachers' discussion and sharing has made the idea of HSW clear, explicit and practical in practice.

- **Awareness of role of argument in teaching science**

Teachers were appreciative of the infusion of research outcomes in the workshops. They indicated that the teacher's perception of the importance of argumentation might affect their motivation to teach argumentation and their lack of experience might be the obstacle as well. The resources shared by other teachers in the workshops extended their personal experiences and opened up reflective discussions. As one teacher explained:

> *"I realised that teachers need to model argumentation structure that pupils would understand."*

Example Resources

Runny Honey

Starters on Variables

Runny Honey Introduction

How Runny is Honey?

- **Lubricating oil in car engines needs to be thick to work properly**
- **Thick liquids are called viscous liquids**
- **Lubricating oil needs to stay viscous at high temperatures**
- **How does viscosity change with temperature, how can we measure it and ....exactly how runny is honey?**

Surfaces are rougher than you think!

This image is taken with an electron microscope.

It shows a tiny screw used in a watch.

To the naked eye this would look very smooth and polished.

The need for lube oil

- Car engines are very complicated with lots of moving parts.
- All the moving parts are lubricated by oil controlled by the lubrication system

So...

....how can we measure how runny a liquid is?

Plan an experiment to measure viscosity including -

- a description of what you will be doing
- a list of the equipment you will need

How Runny is Honey?

Diagram and list the equipment used.

Explain how you will measure the viscosity of honey.

Runny Evaluation

Did your experiment work the way you thought it would? Explain.

What did the test tell you about the viscosity of honey?

Do you think your results are clear or not? Please explain.

What parts of the experiment did you find difficult?

Did these difficulties cause any problems with your results?

How could you improve the practical?

Evaluation of Design

How did you feel about designing your own experiment?

How did planning your own work affect your learning?

From observation to investigation

Theo has just stirred hot chocolate powder into his mug of hot water.
He notices that it dissolved slower than yesterday and thinks it might be something to do with the shape of the mug.

What is the aim of his investigation?

From observation to investigation

When Rachel feeds her rabbit, she sees that he eats more in the evening than he does in the morning.

What should the aim for her investigation be?

From observation to investigation

Levine has a habit of dropping her toast in the morning. Some times it lands spread side up and other times spread side down. She thinks it might be to do with whether she puts marmite or marmalade on it.

What should her aim be?

From observation to investigation

Winston has noticed that his tomato plants grow quicker under the stained glass windows, particularly the ones with a lot of yellow glass.

What is the aim of the experiment?

DVD clips

Clip 1: Teachers' group discussion about policy

In the first workshop, the teachers discussed the "How Science Works (HSW)" component of the curriculum. They were given some questions to prompt them to talk about how they got to know about HSW. They talked about the issues about insufficiency of teacher in-service training about this new initiative; the history of the curriculum change; and the their perceptions of this new initiative in terms of its importance in the class and its relation to other components of the curriculum. They also addressed the issue of assessment and how it is not well unpacked for teaching HSW. HSW has been introduced in 2006 in the national science curriculum for England and Wales at Key Stage 3 (11-13 year olds) and Key Stage 4 (14-16 year olds). It aims to promote understanding of aspects of the nature of science including scientific inquiry, communication of science and science in context.

Clip 2: Teachers' group discussion about challenges of teaching HSW

Teachers were asked to identify the challenges of teaching HSW based on their own experiences. They were asked to write down and prioritise these challenges in a table. In these clips, the teachers raised the challenge of (a) teaching HSW to students, particularly miscommunication in terms of the nature of science; (b) engaging students in scientific inquiry; (c) own understanding of HSW; (d) involved in changes in teachers' roles; and (e) time limitations in teaching HSW.

Clip 3: Model of professional development

The teachers brought examples from their teaching between the 1st workshop and the 2nd workshop. They shared their experiences and resources in the group and got the peers' feedback. The clips show: (a) Davina designed one open-ended experiment about dissolving water and got her colleague, Catherine, to video tape the students' work and interview the students. Davina and Catherine were shared experiences and reflected on their practice in the group with the other teachers; (b) Alex introduced the "card game" as an activity to promote critical thinking skills involved in scientific inquiry; (c) In the 3rd workshop, the teachers were evaluating and reflecting on Steve's runny honey lesson, referring back to what they have discussed in the previous workshops.

Clip 4: Introducing a model of argument

During the workshops, the researchers drew from existing research evidence on argumentation to input ideas and examples about how an 'argument' can be defined. For example, in this clip, from the 1st workshop, the researcher introduced the Toulmin's Argument Pattern as a model and the writing frame derived from it as a practical resource.

Clip 5: Supporting written argument

In this series of clips, the teachers were (a) applying a writing frame to resources that they brought from their own classrooms to explore its relevance and applicability; (b) using the writing frame with a topic example proposed by themselves in order to explore the structure of argument; (c) evaluating and adapting the writing frame. The writing frame had statements such as "My ideas is…", "My

reasons for my idea are…", "I believe my reasons because…" which were derived from the features of Toulmin's model of an argument in terms of claims, data, warrants and so on.

Clip 6: Evaluating assessment tools for HSW

The teachers used the internet to search for potential assessment tools for evaluating HSW in students' learning. The clip shows the teachers' discussion of the assessment tools they found online. The discussion centres around the application of assessment tools and the issue of differentiation of HSW skills.

Clip 7: Steve's Runny Honey Lesson

This clip shows Steve's practical lesson with Year 9 students on investigating the viscosity of honey. The clip includes: (a) how Steve introducing the aim of the lesson with a real-life context and demonstration to the class; (b) students planning and carrying out various practical work in order to address the question of viscosity; (c) Steve reflecting on how and why he implemented HSW.

Clip 8: Catherine's Starters

The clip illustrates Catherine's use of starters in order to promote understanding of variables in different contexts. In the first part, Catherine introduced the purpose of the "starters" to the rest of the teachers. In the second part, a lesson scenario of the implementation of the starters is included.

Clip 9: Catherine on how CPD helps clarify teaching goals and students' needs

Catherine talks about how the project helped her to clarify teaching goals and students' needs on HSW.

Clip 10: Alex on impact of project on his understanding of the difficulties and gaps in HSW

Alex talks about how the project (a) helped him to realise the difficulties of teaching argumentation as a high-level skill and motivating students; (b) improved his awareness of the gaps between the curriculum and teaching, as well as teachers' knowledge and understanding of HSW.

Clip 11: Grace on opportunity to share skills, experiences and resources

Grace appreciated the opportunity offered by the project to share skills, experiences and resources among her peers.

Clip 12: Steve on impact on (a) identity of a science teacher; (b) teachers to pursue their own interests; (c) developing a network of professionals

Steve talked about (a) how the project inspired his reflections on the identity of a science teacher; (b) how he appreciated the teacher-oriented design of the CPD to allow the teachers to pursue their own interest; (c) enjoyed the platform provided by the project to develop a network of professionals.

Clip 13: Craig on experiencing CPD as a newcomer

Craig who joined in the project in the last workshop talked about his experience as a new participant.

References

DfES/QCA (2006). *Science: The National Curriculum for England and Wales.* London: HMSO.

Erduran, S., & Jimenez-Aleixandre, M. P. (2008) (Eds.). *Argumentation in science education: perspectives from classroom-based research.* Dordrecht: Springer Academic Publishers.

Erduran, S., Simon, S., & Osborne, J. (2004). TAPping into argumentation: developments in the use of Toulmin's Argument Pattern for studying science discourse. *Science Education*, 88(6), 915-933.

OECD (2003). *PISA Assessment Framework – Mathematics, Reading, Science, and Problem Solving Knowledge and Skills.* Paris: Organisation for Economic Cooperation and Development.

Suppovitz, J. A., & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom cultures. *Journal of Research in Science Teaching*, 37(9), 963-980.

Toulmin, S. (1958). *The Uses of Argument*. Cambridge: University of Cambridge Press

Zohar, A. (2008). Science teacher education and professional development in argumentation. In, S. Erduran & M. P. Jimenez-Aleixandre (Eds.), *Argumentation in science education: perspectives from classroom-based research*, pp. 245-268, Dordrecht: Springer Academic Publishers.

Using the DVD

If you have a **PC (Windows computer)**, open the folder named PC and run the PowerPoint called MtG.ppt

If you have a **Mac**, open the folder called Mac and run the html file called MtG. Use your browser's back button to return to the menu after viewing each video.

The **Documents** folder has this booklet in pdf format along with other useful resources.

This booklet contains information on a professional development programme and resources for the teaching of argumentation in science classrooms as part of the "How Science Works" Curriculum Agenda in England and Wales.

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University of BRISTOL

SEVENTH FRAMEWORK PROGRAMME

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