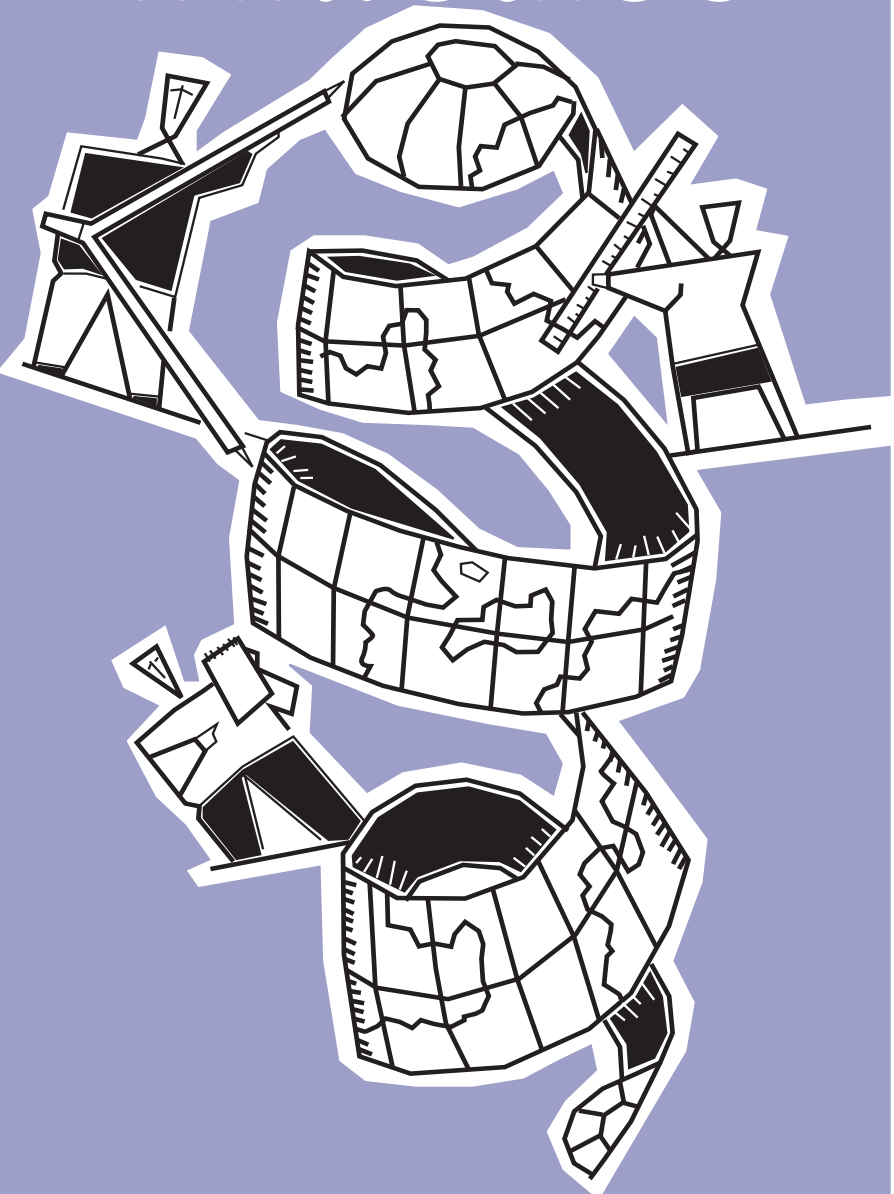
Theory INTO Practice



PROFESSIONAL DEVELOPMENT
FOR GEOGRAPHY TEACHERS

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Mysteries Make You Think

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The Geographical Association

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Introduction

The *Thinking Through Geography* (TTG) group, who have been instrumental in developing the work described in this book, is a consortium of teachers and post graduate certificate of education (PGCE) tutors in the North East of England dedicated to curriculum development, research and in-service training. It has developed a number of flexible strategies designed to infuse 'teaching thinking' into the geography curriculum (Leat, 1998). One of these strategies, based on an idea developed for co-operative group work (Stanford, 1990) has come to be known as a 'Mystery'. One of these Mysteries is included in the Schools' Curriculum and Assessment Authority's (SCAA, 1996) *Optional Tests and Tasks* publication for key stage 3 teacher assessment. It concerns the Kobe earthquake of 1995. The TTG group has gone on to write many more Mysteries and to research their significance to students' learning.

This book outlines the use of Mysteries in geography classrooms and reports on research into their use. Our interest in exploring students' thinking and learning was kindled by our own observations and those of the teachers in the TTG group which seemed to suggest that students go through recognisable, observable stages on the way to 'solving' a Mystery. These stages are associated with increasing levels of cognition, and the students' ability to move through these stages is usually reflected in the quality of their explanations. The Structure of Observed Learning Outcomes (SOLO) taxonomy (Biggs and Collis, 1982) provides a framework for analysing the characteristics of students' explanations which can then be related to the stages. Mysteries, then, can provide an insight into how students are thinking. They are valuable diagnostic tools which also perform a formative assessment function in that we have some idea of the next steps that students may be able to take, given support.

Mysteries are designed to be group activities and we explore the significance of the social setting to the construction of meaning. We also suggest that through wrestling with Mysteries, students build mental models which they can transfer to other problem solving contexts. Many of those who have used Mysteries in the classroom have been pleasantly surprised by the quality of students' discussions and explanations. Encouraging reflection and evaluation of the ways they tackled a Mystery leads students towards awareness of their own thinking (metacognition) and hence to take greater control of it.

We conclude by acknowledging that we are raising more questions than providing answers. Exploring the factors which contribute to students' abilities to do Mysteries holds the potential for influencing those factors and promoting performance. From the teacher's point of view, observing and interpreting how students tackle Mysteries not only helps open a window to their thinking and learning and provide pointers for scaffolding their progress, it also encourages us to look critically for the intellectual challenge for students in all our teaching.

6: What and how do students learn from Mysteries?

We feel it is important to provide some analysis of what students might learn through doing Mysteries and highlight some of the conditions that underpin the learning outcomes. Colleagues have pointed out that the immediate outcomes do not always appear to be strongly related to geography, and imply that this casts a shadow over the place of Mysteries in a subject-based curriculum. We would like to respond to this criticism in three ways. First, as with any well-structured geography lesson, the activity should always be followed by a debriefing/recapping phase in which the geography involved in the Mystery can be made explicit. Second, the follow-up tasks can focus on the key geographical concepts that were embedded in the Mystery at the design stage. Third, Mysteries that are not based directly upon factual events are nonetheless analogous to them. The Mystery can be said to mediate geographical understanding and serve an illustrative and explanatory function in the same way as a story, an anecdote or a case study.

Construction and social construction

The current dominant learning paradigm is constructivism. In simple terms we learn largely, though not exclusively, through what we already know. Our existing knowledge structures are described as schemata. If incoming information makes no sense in terms of what we already know, it will be lost. An effective way of appreciating this is to consider a radio broadcast on a football match, which might go as follows:

> 'Watson threads a neat ball inside the full back, Lee is on to it, he hits it across first time and there is Shearer getting in front of his marker at the near post with a great flick, but Seaman stands up really well and keeps it out at the expense of a corner.'

If you have played and watched football and listened to commentaries before, this passage makes some sense. However, those of you who have managed to avoid football all your life will not have schemata which will assist with the decoding of the description 'Watson threads a neat ball inside the full back' or 'Seaman stands up really well'! Schemata come from experience.

A renewed interest in the work of Vygotsky (1978) has led educators to recognise that construction of meaning is not just a solo activity, it is usually undertaken with others through talk in social settings. Wertsch (1985), Moll (1990) and Mercer (1992) are among the many researchers who have emphasised the collaborative nature of learning, where meaning is jointly constructed and is heavily influenced by context. If we accept that one of the common weaknesses of classroom teaching and learning is that students are not encouraged to use their existing knowledge in understanding new material, then Mysteries offer some salvation. In order to make use of a data item students must understand it. At the 'Setting stage' (page 24), in particular, students may place a considerable amount of data which they do not understand on their 'reject' pile. Watch and listen to them in the early stages of a Mystery and you will almost certainly witness the joint construction of meaning based on existing knowledge of the different members of a group. It is fascinating to gain an insight into the knowledge that students bring to these tasks. Mercer (1992) argues that what counts as context for students is whatever they consider relevant, and the context they create consists of the knowledge they invoke to make sense of the task. We would emphasise that it is the absence of a self-evident solution in Mysteries combined with the ambiguity of some of the data that leads students into constructive talk. Or, as White puts it, the 'slight aura of fuzziness and confusion that is always the backdrop to real communication' (White, 1989).

The 'Setting stage' in Mysteries encourages students to go beyond the literal meaning of the data. Their physical movement of the data slips correlates with the students attaching cumulatively increasing meaning to each item. In the latter stages of 'solving' a Mystery, students use inference - both interpolating and extrapolating beyond the data, which may be based upon existing knowledge and experience. However, to do so students must accept the task as genuinely open and not an elaborate trap. Mason (1996) draws on the work of, for example, Brown and Campione (1990) and Pontecorvo (1990) to focus on the importance of using argument in class. During this 'argument', students are called upon to give explicit reasons, explanations and justifications. In the process of such collaborative endeavour conceptual change is likely to occur as students distance themselves from their own beliefs and entertain others' perspectives. Evidence from video recordings of group discussions in mixed ability groups indicates that Mysteries provide a context within which the more able are supporting the construction of meaning by the less able. It is possible to over-simplify this relationship because Mysteries encourage active participation by students who are poor at writing but who have good verbal reasoning skills, so it is not always clear who is more and who is less able. By moving a data slip to form part of another set, the student must explain and justify a causal chain or a link between factors to their group. Their reasoning has to be externalised thus creating the conditions for shared reasoning. The following extract, taken from a group of able year 9 students who have done a Mystery concerning pressures on Lake District farmers, highlights this process. (The students are aware that the pressures on farmers have led one to commit suicide.)

Emma: We had the cards that we were using and we set them out into groups and once we heard different peoples' cards we found out that they had some cards that we didn't have in our group.
Interviewer: You actually changed your mind?
All students: Yeah.

Interviewer: So can you remember any examples of things you changed your minds on?

Supriya: The four generations part [the fact that one family had farmed the particular farm for four generations].

[later in the interview]

Nathan: Sometimes you only think of one thing and you don't think anybody else is right, then when somebody explains, they explain their view, it makes you think about it.

This snippet illustrates a feature of much of our research into Mysteries. Small-group and whole-class discussions help students exchange ideas. Within this process, they change their minds, but more importantly they build on each other's ideas, fusing their thoughts with those of others to create new meaning. This is further illustrated in the following extract.

Fay: It's better to have someone else's opinion.

Interviewer: Why? I don't think that you are wrong; I want to know why?

Fay: Because you can put your ideas and their ideas together and make it, like, better.

Interviewer: Why is it important to talk about your ideas? If you and I sat down now and talked about our opinions or some of our ideas, why is that better than you deciding on your own?

Fay: You can find out better ideas than you had and make them better ... and make them more exciting and more serious.

The social context is, therefore, crucial to what is learned. The learning is embedded in the activity and it is from the activity that rich understanding of concepts emerge. Brown *et al*. (1989) emphasise that the meaning of a concept continuously evolves with each new occasion of use. They stress that, because application recasts meaning, 'a concept, like the meaning of a word, is always under construction' (Brown *et al*., 1989, p. 34). Concepts which arise inductively from the students' work as they group the data items are likely to be more powerful than those which are encountered through a decontextualised transmission process. The extract on pages 26-27 provides evidence of a group of girls constructing extended understanding of the concept of ecosystems.

Mental models

Mental models nest within constructivist theory. Hatano and Inagaki (1992) use learning to cook to illustrate the importance of mental models. They assert that as novice cooks we are highly dependent on external support (such as a recipe in a book) and on having all the right ingredients and utensils. If something is missing or a few lines of the recipe are obliterated, we are stumped. We progress through a stage of remembering recipes, thus using acquired knowledge, but this knowledge does not transfer in that we cannot interchange some parts of recipes. However, Hatano and Inagaki describe a further

stage that is qualitatively different when we acquire conceptual knowledge 'which means more or less comprehensive knowledge about the nature of the objects and of the procedures (i.e. what they are like)' (Hatano and Inagaki, 1992, p. 116). If conceptual knowledge is flexible in the sense that it changes in response to thinking it is referred to as a mental model:

> 'When we possess a mental model of the target object we can understand the meaning of each step of a given procedure in terms of the change it produces in the object. By running the mental model we can also predict what will occur in situations that have not been experienced' (Hatano and Inagaki, 1992, p. 116).

Mental models, therefore, suggest a way in which knowledge learned in one context can be de-situated and applied to another. Gentner and Stevens (1986) and Halford (1993) also emphasise that mental models are generative, i.e. they allow predictions to be made. Mental models can assist recall because they act as a prompt and thus reduce the amount of information that needs to be rote learned (e.g. 'What was the trigger in this situation?' is a prompt that can help recall).

Do Mysteries supply a context in which students can develop mental models? And, if they do, what supports this development?, and what is the form of the mental model?. The following extract, while not providing conclusive evidence, offers a tentative response to these questions. This is a group of more able year 9 students who have just done a Mystery on farming in the Lake District.

Interviewer: OK, if we go back to thinking about what you've learned, can we pin that down. Is there anything about geography?
Ellen: I wouldn't say that we've learned anything specific today, it's like we're relearning things that we've done in the past, that we've been learning over the two years.
Interviewer: Such as?
Ellen: Background and trigger.
Interviewer: Background and trigger. Right. Is that useful? You're not going to get a question in a geography examination that says ...
Joanna: In projects and stuff. It can help you.
Ellen: For writing essays and stuff, you have all the reasons, background and trigger reasons, it can help you sort of arrange an essay and write it.
Joanna: And if you are going to college you can use it. I think this happened because of background.

[later in the interview]

Interviewer: Do you think your other work, in any other subjects has improved because of that.
Ellen: Geography and history, you use the same skills that you learn.
Carmel: And like in English, we're doing like an AT on listening. We've got to do like a debate, and doing background and trigger that will help for that as well.

This extract indicates that some of these students are de-situating their learning. What they have learned about farming in the Lake District is overshadowed by what they have learned about causation (and handling data, decision making, discussion, etc.). The students know, for example, that in many situations, including analysing the play *Macbeth* in English, they can look for trigger and background factors and use this framework to structure their writing. They also know that in certain types of episodes there will be a chain of events which include a trigger (or triggers) and that these triggers are different in different episodes. The students can use this model to make predictions, for example, if certain background conditions are changed some episodes are much less likely to occur and others become more so. There is much more to learn about causation, relating to probability, trends, strength and classification of factors. The danger here is that this becomes distilled into a rigid set of algorithms about causation that students have to learn in geography.

Work in the USA has shown that more able students require less help to transfer rules and principles to novel problems. This relative advantage grew as the transfer distance (the degree of un-relatedness of the novel context) increased (Brown *et al*., 1992). Mental models are implicated in students' ability to transfer rules and principles, especially in what Perkins and Salomon (1988) term 'high road routes' where the task goes beyond applying a procedure or algorithm to a similar problem. As students become more proficient at organising and classifying data in Mysteries, their confidence in hypothesising and speculating increases. They construct models of the Mystery process itself and then transfer this knowledge to new contexts in geography and other subjects.

Literacy

Wray and Lewis (1997) describe the Extending Interactions with Text (EXIT) model which has been developed to represent the processes underlying student learning from non-fiction text. The EXIT model has ten stages (see Figure 7).

The extract shown on page 38 is taken from an interview with a group of mixed ability year 10 students after they had completed a Mystery. The Mystery allowed them to compare the effects of one hurricane on three areas in the Caribbean and eastern United States. The extract provides evidence that Mysteries can have a profound catalytic effect in promoting interaction with text, which is epitomised in the student's phrase, 'If you are just reading it you hardly take much in'.

Figure 7: *The ten stages of the EXIT model.*

1. Activating previous knowledge.
2. Establishing purposes.
3. Locating information.
4. Adopting an appropriate strategy.
5. Interacting with text.
6. Monitoring understanding.
7. Making a record.
8. Evaluating information.
9. Assisting memory.
10. Communicating information.

At least half of the EXIT stages (1, 4, 5, 6 and 8) are strongly represented in the Mysteries stages we have described (see pages 23-26). Chall *et al*. (1990) provide intriguing evidence on how some American children (mainly from low income families) fall behind in reading scores. The children show slippage on tests of word meaning – especially abstract literary and less common words. Greenhough and Hughes (1998) have speculated that this 'slippage' may be attributed to a lack of opportunity to converse about texts. Language and

Interviewer: Right ... so if Mr K had given you the information in a big paragraph, like a page in a textbook and told you to compare ...
Alistair: It would have been boring.

[later in the interview]

Rachel: If you are just reading it you hardly take much in, but it's like a practical, you get more ...
Interviewer: So you actually need holding and moving things?
Rachel: Yeah. Because if it's in the book you can't rip the book apart and put them in order.
Interviewer: So that helped? Even though you had to have bits of card .. and bits of paper, that would have been quicker than giving you the set exercise?
Rachel: [Emphatically] Yes.

cognition, which are rooted in talking about text to make meaning, become stronger predictors of reading scores than word recognition and phonics. We would argue that Mysteries have a role to play in encouraging comprehension of important geographical vocabulary. Moreover, students tend to use this vocabulary more readily and confidently on subsequent occasions.

Mysteries may also be used to encourage writing. Through the physical manipulation and positioning of data slips meaningful associations are established by the students and these can provide frameworks for written explanations. The SCAA (1997) discussion paper *Extended Writing in Key Stage 3 History* provides examples (albeit using tasks that are not strictly Mysteries) of how this might be approached.

Cognitive skills

Feuerstein (1980) has developed a programme called Instrumental Enrichment (IE) which seeks to improve cognitive skills or functions through modules or instruments. Feuerstein's work draws on Vygotsky's view that thinking is a cultural artefact transmitted through social processes from adults to children. IE is founded on the principle of mediated learning in which the adult assists the child learner in interpreting the task and making sense of the thought processes employed in tackling it. Feuerstein argues that for most lower ability students the problem is not a lack of intelligence but a lack of cognitive functions. An absence of mediation has resulted in these students failing to develop cognitive functions and thus they are culturally deprived. IE distinguishes between three groups of functions - input of information, using the information (elaboration) and output (expressing solutions) (Feuerstein, 1980). Examples of these functions are shown below.

Input functions

- Describing things and events in terms of where and when they occur (temporal and spatial referents).
- Organising the information we gather by considering more than one thing at a time (two sources of information).

Elaboration functions

- Using only the part of the information we have gathered that is relevant, i.e. that which applies to the problem, and ignoring the rest (relevance).
- Having a good picture in our mind of what we are looking for or what we must do (interiorisation).
- Looking for the relationship by which we can tie together separate objects, events, and experiences (projecting relationships).
- Finding the class or set to which the new object or experience belongs (categorisation).
- Thinking about different possibilities and figuring out what would happen if we were to choose one or another (hypothetical thinking).
- Using logic to prove things and to defend our opinion (logical evidence).

Output functions

- Carrying an exact picture of an object in our minds to another place for comparison without losing or changing some details (visual transport).

Instrumental Enrichment represents a pole in teaching thinking programmes, in that it emphasises procedural skills in thinking, with little attention to conceptual knowledge. This is deliberate because the natural client group has repeatedly been unsuccessful within the disciplines of the school curriculum. The 'content' of IE bears no relation to any school subject and the subject matter has been described as abstract and decontextualised in order to provide a fresh start for those students who associate certain school subjects with failure. Clearly IE has 'content', because it is not possible to think about nothing; rather the emphasis is on cognitive functions. Our interview extracts provide evidence that Mysteries offer students substantial opportunities to develop and refine many of the cognitive functions listed above. Further evidence is provided by the following extract.

Interviewer: What do you think you learnt during that lesson?
Sam: We learnt ... like looking at these different cards, we learnt how to read them all and put them into groups ...
Debbie: We learnt how to look into information, like you get one piece of information ...
Rebecca: And put it into lines and stuff.
Alex: We learnt how to group things together and see what might affect other things and then clues ...
Debbie: Like one thing starts another.

Metacognition

Metacognition is an elusive concept which has undergone what has been termed 'construct creep' since Flavell coined the term in 1977. Flavell describes metacognition as representing knowledge of one's own cognitive processes and products including active monitoring and consequent regulation and orchestration of these processes. Its essence concerns the conscious management of thinking.

The following interview involves two very able year 9 girls from another school doing the Kobe Earthquake Mystery. There are strong similarities in the pattern of the stages, however, a number of points of difference are worth noting. First, although they were aided by the manipulation of data slips, these girls never appeared to be as dependent on it for the development of their thinking. Second, they were quicker to form thematic groups in the 'Setting stage' (page 24). Third, the girls were able to be much more explicit about the strategies that they employed in trying to impose order on the data slips (though readers should bear in mind that this may be *post hoc* rationalisation). And fourth, they demonstrated impressive evidence of transfer of learning from other contexts in this process. Our hypothesis is that these students are managing their thinking as they try to use 'storyboarding' as an organising framework: however, they abandon it because they cannot accommodate background (abstract) factors. The girls switch to sorting data into groups, using reliability of evidence as a filter.

Interviewer: You have one at the top there about Japan being a rich country?
Beth: It was like a background [the interviewer and the teacher had not used this word]. It was not in order, it was background, Japan is a rich country and the plates stuff, it's not in any order.
Interviewer: You are forming groups?
Both girls: Yes.
Beth: I thought that they should end up in a line like a storyboard, but they didn't all go [storyboards had not been mentioned].
Interviewer: Where have you used storyboards?
Both girls: In English.
Interviewer: What didn't fit?
Beth: The backgrounds.
Amrita: There were the buildings and things that contributed to her death, but not directly.
Interviewer: Have you done background before?
Amrita: [looking at Beth] Once or twice in year 8. We did not realise that we were doing it. New things kept cropping up and things changed ... so it changed. We were looking at evidence and sorting and re-sorting.
Interviewer: Have you looked at evidence before?
Both girls: In history.
Amrita: In history we do sources, which sources are reliable and which are unreliable.

Mysteries provide an inviting practice ground for the development of metacognitive awareness, control and self-regulation for three reasons:

1. They are open tasks which allow a broad range of strategies to be employed in sorting the data and building explanations. Students have a real choice about the route they take, so they have something which can be reflected upon.
2. The physicality of the data manipulation allows their strategies to be observed.
3. The physical manipulation invites students to alter explanations and reasoning - by moving a data slip the student has some automatic control over strategy. Students are encouraged to think again.

The option to 'think again' may be one of the most important ground conditions for metacognition because it allows for what is termed 'executive control', which Brown (1978) proposes as the essence of intelligent activity. Nisbet and Shucksmith (1986) analogise learning in terms of information technology, with hardware representing ability, software as the procedural skills we have learned and the operator of the system as metacognitive executive control.

Theory INTO Practice

The aim of *Theory into Practice* is to take aspects of current research into geographical education and deliver them directly to the classroom practitioner. Geography teachers from across the professional spectrum will be able to access research findings on particular issues which they can relate to their own particular context; thus students will benefit from new and well-informed approaches in the classroom, whilst teachers will keep their own professional development fresh and up-to-date.

A key element in the series is to encourage teachers to reconsider their thinking about teaching and learning in geography; we hope to reinvigorate the debate about how to teach geography and give teachers the support they need to revisit essential questions like:

- Why am I teaching this topic?
- Why am I teaching it this way?
- Is there a more enjoyable/challenging/interesting/successful way to teach it?
- What, how and why are the students learning?

The books in the series will provide a framework for challenging current assumptions about the nature of the subject in schools and answering these questions in new and well-informed ways.
Each book in the series has been contributed by acknowledged experts in their particular fields.

Mysteries Make You Think

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This book outlines the use of Mysteries in the geography classroom, reports on research into their use and discusses how they can help develop students' thinking skills.

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