

Education Forum
on
Teaching Thinking Skills

Carlton Highland Hotel, Edinburgh

15 May 2000

Report

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The views expressed are those of forum participants and are not necessarily those of the Scottish Executive Education Department or the Scottish Council for Research in Education

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Education Forum Teaching Thinking Skills

Monday 15 May 2000

The Carlton Highland Hotel, Edinburgh

Programme

1000 – 1030	Arrive and coffee
1030 – 1045	Welcome Colin MacLean (HM Deputy Senior Chief Inspector of Schools)
1045 – 1100	Introduction Valerie Wilson (Director, SCRE)
1100 – 1115	Psychological perspective Bryan Kirkaldy (Education Services Manager, Fife Council)
1115 – 1130	Personal Experience Heather Forrest (Newmains Primary School, North Lanarkshire)
1130 – 1230	Discussion groups — What are thinking skills? — How can they be useful? — Can they be taught?
1230 – 1330	Lunch
1330 – 1345	Personal Experience Kevin Logan (Millburn Academy, Inverness)
1345 – 1500	Discussion groups — What approaches have teachers taken? — How can best practice be shared? — What support is needed? — What conclusions can we draw? — Where do we go from here?
1500 – 1515	Tea/ Coffee
1515 – 1600	Plenary Sam Galbraith (Minister for Children and Education)

Preface

If education research is to be effective in informing policy development, it must relate directly to what happens in the classroom. This is the premise on which the Education Forum is founded. What seemed to emerge from a preliminary analysis of thinking skills, is that there are many people working in this area, but that little work has been done to bring them together. This Forum represented the first step in redressing this, and many classroom teachers from across Scotland gave their time to come together to share their ideas and experiences.

The day's discussions demonstrated that there are many innovative methods being used to improve pupils' learning, and equip them with effective thinking skills for life. It also became clear that more work needs to be done in facilitating greater communication and co-ordination within the thinking skills community and in developing evidence-based research. This report, which will be disseminated widely to the research community, to education authorities and throughout the Scottish Executive Education Department, will form the first step in this process.

The Scottish Executive has recently proposed five national priorities in education, one of which recognises the importance of equipping young people with fundamental transferable skills, including the ability to think critically and solve problems. Teaching thinking skills gets right to the heart of that priority.

The Scottish Executive is committed to raising standards in education, and recognises this depends fundamentally on the practical experience, skills and understanding of learning and teaching held by teachers. Further meetings of the Forum are planned, to consider other aspects of the educational process, and to draw further on this valuable resource.

Welcome to the Forum

Colin MacLean, HM Inspectorate of Schools

The Forum was opened by HMSDCI Colin MacLean who explained the purpose of the meeting and the reasons why the topic – thinking skills – is important.

Welcome to the Education Forum on Thinking Skills.

Firstly – Peter Peacock has had to tender his apologies due to other commitments today and is unable to open this Forum. However, Sam Galbraith, Minister for Children and Education, is looking forward to joining you this afternoon for the final session, to listen and respond to the issues arising from your discussions, and to provide his perspective on the part played by the Forum in taking forward the Government's priorities for education.

Today's Forum is the first in a planned series of twice yearly seminars. The concept is to provide an opportunity to bring together the practical experience of teachers in the classroom, with the perspectives of those involved in research and policy development. It is encouraging to see so wide a representation from researchers, education authorities and the independent sector.

I think it is vital that the seminars are seen to be relevant and productive; and to achieve their objective of applying the evidence from educational research to the practical circumstances in which learning and teaching take place. This first Forum – on thinking skills – is at the cutting edge of educational research and lies at the core of what teachers are trying to achieve. As such, it is an ideal topic for the first of these events.

The Forum, of course, sits within a context of a range of other activities. The Executive commissions research on key topics and disseminates results. There has been a welcome recent growth in the interaction between Universities and Teacher Education Institutions – with potential benefits for teachers and learners as practical experience and academic disciplines strengthen each other. Academics from across the UK and beyond with a deep knowledge of the education system continue to make key contributions to developing thinking. I think we are seeing a growth in the awareness of the rich variety of research about education. The Forum plays two key roles in this process:

- to ensure that policy makers and researchers are tuned in to the key issues facing teachers and learners which would be illuminated by research evidence
- to help teachers keep up to date with the current state of research.

The choice of topics for these fora is wide. It is important that they focus on topics with strategic importance to national education policy, and with relevance to the Government's objectives of:

- enabling all learners to achieve their full potential
- promoting social inclusion
- encouraging teachers' continuing professional development.

A seminar on thinking skills is relevant to all of these criteria.

The purpose of a seminar on thinking skills

A forum such as this, draws together ideas associated with the physiological, psychological and pedagogical dimensions of learning. Our collective understanding of each of these is developing rapidly. The hypothesis to be considered today is that thinking can be taught and improved. It gives rise to a whole series of interesting questions:

- ❖ *Do we have an agreed view on precisely what are the thinking skills to be taught and developed?*

The background papers point us to a wide range of definitions, based on psychological and epistemological theory. I suspect we can't have a static definition, but have to take a pragmatic view – and base our thinking on a practical working premise. The explosion of knowledge, and of ways of accessing such knowledge, inexorably drives us to a position in which our assumptions about thinking skills have to be dynamic – if only to keep pace.

- ❖ *How best should we put thinking skills into context? Does the context matter?*

Here we need to consider some key issues about the nature of the curriculum and indeed the social functions of schooling as part of the individual's educational development.

The process of education, and more specifically of formal schooling, is more than simply cognitive. There are other equally important dimensions. Thinking skills cannot be divorced from the development of positive values and attributes :

- Effective learning has a social dimension – learning from and with others.
- Effective learners need motivation, confidence, resilience, concentration, stamina, and the will to keep on learning!
- The effects of learning arguably should benefit not only the learners but can be applied to allow participation as citizens for the greater good – socially, politically, economically, culturally.

Thinking skills alone will not provide these features. They may facilitate, but will not necessarily ensure important ingredients of education such as initiative, enterprise, flair, imagination, creativity. We just need to keep these attributes in mind during our discussions.

Can and should learners actively ‘learn how to think’? If so, is this an abstract skill to be learned – or should they learn in the context of specific curriculum content? Do they learn how to think during their science lessons because that helps them become better scientists – or because science provides a context in which to develop generic thinking skills – or both? Let's take three topical examples: how do we prepare young people to think about the issues associated with the use of Genetically Modified Organisms (GMOs), the repeal of Section 2A, their choice of post-school destination? How do we give them the confidence that they have the thinking skills, as well as the personal and interpersonal skills and the knowledge, to form well-balanced views on these complex issues? We face a series of questions:

- Do we need to develop new ways of thinking to cope with new technology and make the most of the opportunities it offers?
- If we improved learners thinking skills – would we help them get better at areas of the curriculum they have traditionally found difficult?
- How best can thinking skills be developed?
- As with all core skills – how does the school plan and manage that process to ensure coherence and consistency of approach?

The conference papers set out the classic practical problems facing those who determine and deliver the curriculum. Do we move forward with: a specific programme of study; by inserts within subjects like maths and history; or through the broad subject curriculum more generally. The simple answer is ‘whatever works best’. Identifying what approach is potentially most effective for individual learners – and ensuring it is effective – is of course much harder.

❖ *How best can thinking skills be assessed?*

Again we have classic dilemmas about the focus and purpose of assessment, potential bias from cultural assumptions; distinguishing thinking skills from the context in which they are delivered; and various other tricky issues. Underlying that is another question: can we assess thinking skills – if not, how do we know we have successfully helped learners to acquire these skills – and how do we improve our teaching?

Conclusions

I believe it is unrealistic to expect definitive answers to these questions, nor should there be in a dynamic education system. What does matter is that the Educational Forum raises and debates the issues and helps us individually and collectively move the debate forward and influence educational policy and practice for the better.

While there are many uncertainties, I think we are increasingly sure of three things:

- Learners need to have greater self-awareness than perhaps many do at present, of their learning styles and preferences. Thinking skills, however packaged, are directly relevant.
- Educators need to have an equal knowledge of learning styles; the needs of learners; and the potential barriers, individual and institutional, to learning. Thinking skills, however packaged, are directly relevant.

- Early intervention in the broadest sense is vital to address problems in learning. Thinking skills, however packaged, are directly relevant.

I think the bottom line for us is summed up in one of the references in Valerie Wilson's conference paper when Resnick talks about 'a new challenge to develop educational programmes that assume that all individuals, not just an elite, can become competent thinkers'. I think the message needs to be applied well beyond the bounds of cognitive psychology to the national education system – and that is the key purpose of today's Forum.

Introduction

Can Thinking Skills Be Taught?

Valerie Wilson, Scottish Council for Research in Education

‘Can thinking skills be taught?’ is the question which we are here to discuss. During the past ten years, increasing interest in ‘thinking skills’ has developed in numerous countries. However, as MacBeath (TESS, 20.6.97) reports, all are quick to admit to ‘being only on the edge of understanding the inner magic of the thinking brain’.

I wrote the literature review paper which was circulated prior to this meeting, and which will, I hope, aid your discussions today. I do not want to go over the paper in detail now as I have already had ‘my say’ in writing, but rather to give you some indication of the way I approached the task and my own conclusions from having searched the published literature. I hope this will provide insights to the review and point out key areas which still need to be addressed.

My main aims are threefold:

- ❖ to introduce the topic for discussion today
- ❖ to describe the review paper and how it is structured
- ❖ to indicate areas which I think need further exploration.

Context

In Scotland, as in other countries, there has been much interest and increasing activity in teaching thinking skills, amongst both teachers and teacher educators. Although there are as yet few published accounts or research reports describing this work, some networks have already formed. Our discussions today should be located within an overarching context.

Overarching context for this forum

- ❖ a long history of interest in the workings of the mind by members of disparate disciplines
- ❖ the possibility now with the development of magnetic resonance imaging of observing the brain ‘at work’
- ❖ a dissatisfaction with the concept of intelligence as one stable measurable quality (Gardner, 1993)
- ❖ a renewed interest in the ways in which children think
- ❖ the belief that teachers can improve children’s thinking with specific interventions.

It is now over fifteen years since Professor John Nisbet, formerly of Aberdeen University Education Department, undertook his earlier work on thinking and learning to learn which he published in *The Seventh Sense* with Janet Shucksmith. Since that date, others have joined the debate. More recently Dr Carol McGuinness of Queen's University Belfast reviewed the evidence for the Department of Education and Employment and I think this signifies how much the topic has moved up the policy makers' agenda. I know some of you attended the seminar at the DfEE to launch that review and are, therefore, familiar with the direction this debate has taken.

A question of definitions

What then do we mean by the word 'think'? Here I would like to stress three main points all of which impact on our discussion. The first is that it is important to demythologise the topic. Reading through the published work, it becomes apparent that much of the literature is couched in terms which are less than clear and helpful to informed decision making.

Thinking: a world of metaphors and myths?

- ❖ The brain is often portrayed as a 'private space' by earlier philosophers – the so-called Cartesian myth which Ryle describes as follows:
The working of one mind are not witnessable by other observers; its career is private. Only I can take direct cognisance of the states and processes of my own mind. A person ... lives through two histories, one consisting of what happens in and to his body, the other consisting of what happens in and to his mind. The first is public, the second is private. Ryle, 1962
- ❖ More recently the metaphor of a 'computer' is used.
- ❖ Others suggest that the brain is 'just another organ' which operates more like a 'jungle' rather than a logical algorithm.

The practical implications for teachers are, I believe, that it is becoming more difficult, if not impossible, to separate out the physical influences on children from the complex mental processes of learning. We see this demonstrated in classrooms but what do we mean by 'thinking'?

Different meanings of the word 'think'

- ❖ Everyday use of the word: 'think' as a synonym for 'believe' / 'suppose'.
- ❖ When doing something else a person may say 'thinking about what I am doing' meaning paying heed/attention to the task.
- ❖ Special sense: 'thinking' as an 'intellectual/high level process'.

Once we have cleared away some of the myths that surround this topic, we are still left searching for an essential definition which will allow teachers to apply it in their classrooms practices. As a way forward, I think it is helpful if we separate the two concepts: thinking and skills?

What are 'thinking skills': a way of looking at the problem

- ❖ Thinking = the process of cognition, knowing, remembering, perceiving and attending
- ❖ Skills = the acts of collecting and sorting information; analysing, drawing conclusions, brainstorming, problem-solving, evaluating options, planning, monitoring, decision making and reflecting

This distinction was the starting point for my review. I tried to make sense of the literature by posing a series of questions: questions which I thought teachers might ask and which need to be answered. These include:

- ❖ What do we understand by the question?
- ❖ What does science tell us about thinking?
- ❖ What are thinking skills?
- ❖ Why are they thought to be important?
- ❖ Which approaches have been used?
- ❖ What does published evaluation evidence tell us?
- ❖ What conclusions can we draw?
- ❖ Where do we go from here?

By working with the published research, it becomes evident that there are two, possibly three ways in which others have approached the issue of teaching thinking skills. This finding is supported by both John Nisbet (1993) and more recently Carol McGuinness (1999). These approaches are:

- ❖ specifically designed programmes
- ❖ infused across the curriculum
- ❖ embedded in a particular subject.

Both are problematic. If on the one hand teachers choose to use one of the many commercially produced specific thinking skills programmes, then they very quickly encounter difficulties of transference. How can they ensure that their pupils/students can apply skills learnt in one context to other situations? Alternatively, if teaching thinking is embedded in a particular curricular area, there is no guarantee that learners can isolate it from its context and apply it more generally to other situations. This is a dilemma which we need to explore today.

Does the evaluation evidence help us resolve this underlying dilemma? Again there is no simple answer to emerge from published sources. I would argue this results partly from the magnitude of the problem: it is inherently difficult for an evaluator to 'prove' that any educational intervention is associated with a specific set of outcomes. We all know just how complex learning is and the many factors which affect pupils' performance, so to seek a definitive answer is to misrepresent reality. But what clues do we find in the literature?

What does the evaluation evidence tell us?

- ❖ some evidence of improved performance
- ❖ mainly contradictory or small-scale
- ❖ little third-party independent evidence

What would convincing evidence look like?

Coming to the literature as someone who has no prior connections with teaching thinking skills, I encountered what I would describe as the almost proselytising zeal of much of what is written. This may be a reflection of legitimate enthusiasm and I may be an over-cautious researcher. Carol McGuinness, a respected researcher, argues that there is now sufficient accumulated evidence for us to formulate a framework with which to move forward. This may be the case. There are certainly implications from the evidence of which we need to be aware. I think these are:

Implications of evidence and theories for teaching thinking skills

- ❖ Brains are portrayed as under-used and, therefore, capable of further development by stimulation.
- ❖ Learning is seen as requiring active participation by learners who learn best in a social environment in which they give meaning to their own experiences.
- ❖ To build the necessary conceptual schemata, learners must be supported by teachers (Vygotsky's scaffolding) who gradually extend the learning challenges and provide appropriate feedback.

Researchers are often criticised by practitioners for not focusing sufficiently on problems which practitioners face. I suspect that I am conforming to type today by 'sitting on the fence' and forgetting that you must make decisions about what to teach and how to teach it. What conclusions then have I reached?

What then do I think?

- ❖ We have a better 'picture' now of brain, mind and intelligence.
- ❖ We have the beginnings of a framework for learning but this should include differentiating between specific skills and more general learning strategies.
- ❖ I find it difficult to comprehend 'context-free' thinking or 'scaling-up' of small scales experiments.
- ❖ Embedding thinking skills (as approaches to learning, self-evaluation etc plus some specific 'skills') within a subject seem to make most sense to me.
- ❖ It is over to you as teachers: What do you think? What is happening in Scottish schools? How can research help you evaluate what you are doing?

Robert Fisher is one of the best known advocates of teaching children to think, and I know some of you have already benefited from Dr Fisher's approach through in-service events in your authorities. He summarises the factors which influence problem-solving and represents them as a Venn diagram. I find this particularly

helpful because it accords with what we already know about the importance of situated learning: learning is not just about improving the processes of thinking or cognition. I do not need to remind you of how important children's previous experiences and attitudes are to achieving positive outcomes. This does not, of course, imply that technical processes cannot be improved and, therefore, what we are really here to discuss is not teaching thinking *per se*, because most humans do that naturally, but rather how children can be helped to become more effective thinkers.

Some factors which influence the problem-solving process

- ❖ abilities, eg critical thinking, cognitive abilities, memory
- ❖ experiences, eg previous experiences, age, familiarity with context
- ❖ attitudes, eg motivation, stress, interest, confidence, self-esteem, anxiety, perseverance, resistance, pressure.

I look forward to hearing your discussions today. I hope the paper previously circulated will provide a framework for those deliberations and that we will identify and share the work which teachers are undertaking in Scottish primary and secondary schools. Perhaps the final word should go to a headteacher rather than a researcher who observed:

Postscript

A headteacher comments on a teaching thinking skills programme:

- ❖ *I don't know what effect it has had on the children but it has certainly made my staff think more.*

de Bono (1991, p.26)

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Psychological Perspective

Bryan Kirkaldy, Fife Council

Bryan Kirkaldy, an educational psychologist from Fife Council, provided a psychologist's perspective on how current thinking in developmental psychology informs the debate about thinking skills.

Aim

Bryan Kirkaldy explained that the task of educational psychology is to apply the main findings from developmental psychology to everyday issues of learning at home and at school. By way of illustration, he would refer to evidence from infant interactional studies. In the first part of his presentation he explained the lessons to be learnt from studies of child/mother interactions – a ‘synchronised dance’ of social and communication exchanges – conducted at Edinburgh University.

Developmental psychology

The key findings from interactional studies are that from the early weeks of life infants are:

- ❖ predisposed to social communication
- ❖ equally active partners
- ❖ capable of ‘conversational’ exchange
- ❖ capable of thinking.

The thinking is ‘visible’ as exemplified in videos in which the pauses for reflection characteristic of adult conversation can be seen in very young infants’ behaviour. These studies indicate that language, thinking and social interaction are not easily separable, but are intertwined to form part of a necessary whole.

Child development studies show a massive development in thinking capacity occurring from 0–5 years of age. There is growth both in the size of the brain and in thinking. The conceptual, thinking tools used in social interaction build up with practice and usage in a cumulative way. This provides the architecture of a conceptual framework and allows learning to accelerate. Although most learning during these early years is incidental and little is planned or taught, the role of adults is crucial in providing a ‘scaffolding’ to support the child’s development. Thinking and learning can, however, be disrupted by various problems connected with, for example, sensory difficulties or ill health but also with disruptions to social interaction, resulting, for example, from social, family and mental health stresses.

Current child development experiments indicate that conditions that promote effective learning and thinking for children are similar to those required by adults. Namely:

- ❖ personal relevance
- ❖ personal meaning
- ❖ personal purpose
- ❖ plenty of experiential practice.

Translated into classroom terms a number of features are conducive to developing thinking skills:

- ❖ high topic and task relevance to the learner
- ❖ the adult focusing on the child's intention so as to supply the best 'scaffolding'
- ❖ encouraging questioning, especially the use of open-ended questions (for example, the work of David Wood at Nottingham University)
- ❖ encouraging thinking aloud and expressing opinions and uncertainties
- ❖ a model of the teacher as manager of interactions among peers rather than imparter of knowledge.

Thinking and learning in a social context

The presentation concluded by turning to a key issue for secondary teachers, based upon a broader perspective of the ways in which young people think. Bryan Kirkaldy cautioned against a reductionist view of thinking and learning. He firmly believed that thinking and learning are essentially social. Any attempt to reduce them to a set of specific teachable skills would run the risk of artificially focusing on one fragment of a holistic process; this would not be conducive to effective learning. He asked:

- ❖ When is success failure without effort?

The big issue for many adolescents was expressed in the above – the choice they made between the personal investment of time, effort and self-image into aiming for scholastic success (and risking 'failure'), and the alternative subversive subculture of *not* pursuing scholastic success often described as disaffection. The choice is heavily affected by social variables, especially the peer group which assumes a great importance at this age. It was suggested that as adults we need to understand the psychology of thinking that goes into this choice and have more of an influence on the social motivations which determine it if we are to improve learning and teaching for those pupils who are most at risk of social exclusion.

Personal Experiences

Heather Forrest, Newmains Primary School

Heather Forrest, a primary teacher, who was introduced to thinking skills while on a teacher exchange visit to Australia, gave a personal view of her experiences.

Aim

Heather Forrest described how she was introduced to the concept of teaching thinking skills during her year abroad. The aims of the session were to:

- ❖ describe the context in which she experienced the use of de Bono's *Six Thinking Hats*
- ❖ give an overview of the programme
- ❖ outline the planning, implementation and evaluation of the programme
- ❖ offer some personal views on the programme.

The context

Heather Forrest explained that the de Bono programme was one of a range of innovative approaches introduced in the private Australian school in which she had taught. It aimed to address concerns with pupils' attitudes and achievement. An initial assessment indicated that the school needed to find ways to help children take more responsibility for their own learning and to know more about how they think. The strategy was an attempt to teach thinking without indoctrination; to deal with issues of concern to pupils and to look, in particular, at issues of boys' under achievement.

The programme

The *Six Thinking Hats* approach is designed to focus children's attention on different types of thinking about problems. It associates each type of thinking, for example, negative, positive, factual, imaginative, with a different coloured hat. The hats are:

The Six Thinking Hats

- ❖ black for negative
- ❖ yellow for positive aspects
- ❖ white for facts and details
- ❖ green for imaginative
- ❖ red for emotions
- ❖ blue for reflection and metacognition.

Children were encouraged to say which hat they were wearing, and also to vary their hats, as they addressed problems in undertaking their work in the classroom. This not only provides a framework for introducing children to ways of thinking but encourages them to reflect on their own thinking.

Planning and implementation

Heather went on to describe the planning in which her exchange school engaged in order to support the implementation of the Six Hats Programme. The headteacher and reading recovery teacher underwent training in the approach and acquired supporting materials. They then led whole-school training for the staff. Implementation began with a 'readiness' level of the programme during which children were introduced to the different kinds of thinking and the use of open and closed questions and statements. 'Show and tell' offered opportunities to practise these developing skills. Only when this stage had been established were the *Six Thinking Hats* formally introduced.

Initially the class concentrated on only one coloured hat or type of thinking at a time. At a later stage, groups within the same class were assigned a different hat and asked to report back from the perspective of the 'hat' they were 'wearing'. This was followed by groups rotating through the different types of thinking in order to practise the skills involved.

Personal views

Did this method work and can it be transferred to Scottish schools? Heather Forrest explained that as she had been on an exchange visit, she left while the implementation was still underway. However, subsequent contact with the Australian school had provided her with feedback on progress. At the end of four years, 'readiness' activities were an established part of teaching and learning in years 1 and 2. Hats were used in years 3 to 6 and a Lipman-based philosophy¹ programme was being introduced in year 7 and carried through into the senior school. Children seemed to enjoy the programmes and find them useful; parents were now familiar with the language which had been shared with them. However, the school felt it was still too early to judge the long-term effects of these approaches to learning.

Heather's personal view is that the *Six Thinking Hats* Programme is a 'fun way' to focus on thinking and also a way of involving the whole community in learning. She was, however, convinced that success hinges on teachers' skills and commitment, and stressed that the Australian school supported the implementation with in-service training on co-operative learning techniques. In her current school she was finding it difficult to replicate her experiences without the necessary resources or the whole-school approach which had supported her exchange visit. She did, however, believe that elements of the approach could be introduced into circle time and that staff meetings would also benefit from examining the ways in which staff address issues using different ways of thinking.

¹Lipman, M. (1999) *Thinking in Education*. Cambridge: Cambridge University Press.

Personal Experiences

Kevin Logan, Millburn Academy

A second personal perspective was provided by Kevin Logan, a secondary school teacher from Highland Council.

Background

Kevin Logan is a mathematics teacher who has been involved in developing thinking skills for over ten years in schools within Highland Council. He has experiences of:

- ❖ developing a philosophy module for SCOTVEC for use with S5/6 pupils
- ❖ embedding thinking skills within mathematics in secondary schools
- ❖ attending conferences and staff development activities which allow teachers to self-reflect
- ❖ reconsidering the central role of the teacher in S1 and S2.

Experiences

Kevin Logan explained how his interest in thinking skills arose from his concern about individualised learning for pupils in S1/2. He believes there is a need for research into teaching and learning to form a sound basis for both, and sees thinking skills within this wider context of improving teaching and learning. In particular, he has found some of Robert Fisher's 'infusion' strategies very helpful, because they make explicit what the teacher is doing and why. Fisher 'unpacks' his theories and translates them into classroom practices. For example, when questioning, Fisher recommends that teachers should increase the time they wait for a pupil to respond to three seconds. He also recommends that teachers should know exactly what they want from questioning and let pupils know. This will encourage deeper thinking.

John Nisbet and Brian Boyd have also been influences on Kevin's classroom practice. He highlighted the importance of John Nisbet's view that what teachers need is time to think. During staff development events, Brian Boyd had located teaching thinking skills within the context of what we know about school effectiveness. Both are helpful.

Kevin pointed out that most authorities on this topic stress the social aspect of learning and thinking. From the perspective of a maths teacher, Kevin Logan saw that many pupils came to the subject with pre-formed negative attitude, a feeling that they 'can't do it [maths]'. This had to be confronted if pupils were to move forward with their

thinking and Kevin had experimented with group work and collaborative learning in maths in order to address the problem. Kevin described how he begins each lesson with questions which demonstrate what pupils can remember from the previous lesson, week and year in order to establish links with prior learning and aid reflection.

Where do we go from here?

Kevin Logan identified four key aspects of a strategy for taking thinking skills forward. These are:

- ❖ interest
- ❖ research
- ❖ teacher support
- ❖ Scottish school curriculum.

Addressing each in turn, Kevin argued that:

- There is already a lot of interest in thinking skills and lots of good work being undertaken in Scottish schools.
- Research evidence is limited at present and there is a need for evaluation of the effects of teaching thinking skills.
- Support for teachers is crucial and although packages may provide a good starting point, teachers need the background and time to reflect on them and their own practice.
- It is important to recognise that thinking is not a new add-on to the curriculum, and there is a need to establish a balance. He believes it is possible to tackle the process skills and still complete the syllabus. The former should, he argues, aid the latter.

Personal views

The presentation had commenced with Kevin asking participants to note the first aim of Maths in the 5–14 Guidelines. At this point, he reminded the audience that the aim was ‘to understand the nature and purpose of mathematics’ which he believed was in tune with a process skills approach. Robert Fisher had quoted the Scottish curriculum guidelines, specifically English 5–14, as placing thinking firmly in the curriculum. The presentation concluded with the assertion that ‘given the right backing we [teachers] can take this forward.’

Discussion Groups

Participants (see Appendix 1) were allocated to discussion groups according to their sector interests – three groups of primary school teachers and another three groups from the secondary sector. The composition of the groups remained constant throughout the day. The aim of the small groups (see Appendix 2) was to provide participants with the opportunity to discuss their views of the research findings in the light of their own experiences as practitioners. Eight questions were posed and the groups' main conclusion are summarised below.

The questions were:

- What are thinking skills?
- How can they be useful?
- Can they be taught?
- What approaches have teachers taken?
- How can best practice be shared?
- What support is needed?
- What conclusions can we draw?
- Where do we go from here?

Question 1. What are thinking skills?

Most agreed that 'thinking skills' are:

- ❖ the mental processes involved when problem-solving
- ❖ a complex range of mental processes.

Participants suggested that the process entailed children/young people being able to:

- ❖ collect information
- ❖ sort it
- ❖ analyse it
- ❖ brainstorm to determine alternative explanations
- ❖ reflect on the process.

However, most groups pointed out that these general and specific skills should be located within the overarching context of increasing learners' self-esteem, building on their strengths and creating an ethos of achievement.

Question 2. How are thinking skills useful?

All participants saw value for both learners and teachers in developing thinking skills. They believed that the process would help children/young people in various ways:

Thinking skills help learners

- ❖ consider issues from other people's points of views
- ❖ value other people's opinions
- ❖ respect others
- ❖ recognise differences
- ❖ be motivated to learn and enjoy learning
- ❖ raise their confidence/self-esteem
- ❖ liberate their thinking from the constraints of always looking for correct answers to problems
- ❖ recognise the importance of teamwork
- ❖ be more aware of how they prefer to learn
- ❖ prepare for life after school and for citizenship.

While the benefits for teachers include:

- ❖ helping them to recognise different learning styles and reflect more on teaching and learning
- ❖ increasing their own motivation
- ❖ making teaching more exciting and engaging
- ❖ cutting down on discipline problems because children enjoy the activities
- ❖ raising teachers' esteem because it is obvious pupils are enjoying learning.

All participants agreed that the role of teacher is critical to success. They foresaw a powerful change of relationship from the teacher as the 'fount of all knowledge' to the teacher as co-learner with the children. By listening to what children think and how they approach problems or issues, participants believed that teachers can continue to learn. Some were concerned that the teaching of thinking skills has been linked too closely with short-term benefits in pupil attainment, but others pointed out that children's engagement with the activities was a potent measure of success.

Question 3. Can thinking skills be taught?

From most participants, the answer was an overwhelming 'yes'. However, many qualified their support by pointing out the need to embed specific approaches within an overall teaching and learning strategy at school level. They believed that thinking skills were already implicit in the curriculum, and that many teachers were teaching them within different curricular areas. They did, however, recognise that it was difficult to distinguish between benefits from teaching thinking skills and those which resulted from teachers' personal enthusiasm to motivate children. This remained an issue to be resolved.

Although most thought it possible to teach thinking skills, a few notes of caution were sounded. These included the need to:

- ❖ distinguish between teaching thinking skills and learning thinking skills. Participants believed that although they could teach thinking skills there was inadequate evidence to show that children had actually learnt them.
- ❖ bear in mind individual learning techniques when determining teaching approaches, even for thinking skills.
- ❖ remember that using computers which may provide initial support for teaching thinking skills, should be accompanied by opportunities for pupils to apply the techniques learnt and demonstrate their transference to other areas.

Question 4. What approaches have teachers taken?

Participants pointed out that teaching thinking skills is not new in the curriculum in Scottish schools and reported a surprising number of approaches with which they were familiar. Specific methods and more generalised approaches discussed included:

- ❖ Mind mapping was a recurring theme, which some suggested was both a thinking skill and a possible 'starting point for beginners'. Some Education Authorities had arranged in-service training on this method.
- ❖ Brain gym, an exercise-based programme, which some teachers had used as a way of stimulating children's thinking at the beginning of each school day.
- ❖ Circle Time which provided opportunities for children to discuss issues freely and reflect on attitudes and values.
- ❖ Independent and collaborative learning which were linked to attempts to improve pupils' self esteem.
- ❖ A 10-week after-school study-support programme at P7 which included mind mapping and Brain Gym linked to improving pupils' self confidence.
- ❖ The creation of a structured activities room which was dedicated to encouraging problem solving and collaborative learning.
- ❖ A strategy in which every teacher asked 3–5 questions for pupils to answer at the beginning of every lesson to remind them of what they had learned yesterday, last week, 3–4 months or even a year ago.
- ❖ 'Thinking time' when teachers posed oral questions was increased.
- ❖ Thinking skills incorporated into the Personal and Social Education (PSE) course from S1–S4: to ensure its success, it was staffed by teachers, who volunteered for the role and were interested in the approach.
- ❖ Use of prepared packages, eg the Learning File, developed by Matthew Boyle, and Cognitive Acceleration through Science Education (CASE).
- ❖ A cluster group strategy to promote a continuity of teaching thinking skills between primary and secondary school.
- ❖ 'Focus Days' which were developed for each year group, during which time conventional classes were abandoned and smaller discussion groups with a focus on thinking skills were introduced. Help from outside agencies was utilised. The purpose was to create a context-free situation in which pupils and teachers were freed from curricula constraints. Experience indicated that pupils either liked it or hated it, but most reacted positively.

Question 5. How can best practice be shared?

Groups identified a number of ways in which good practice could be shared. As a first step, they proposed that Education Authorities should collate examples of good practice in teaching thinking skills to form a national picture of innovative approaches. Participants knew of one authority which had already begun an audit of teaching thinking skills. Information could then be shared by arranging:

- ❖ feedback time between teachers and pupils within classes and through a pupil council
- ❖ teachers sharing the results of small-scale action research with colleagues
- ❖ teachers informing parents of the teaching methods being used
- ❖ cluster groups working together to share practical experiences and information from in-service events
- ❖ workshops to promote staff development
- ❖ networking, via email and the National Grid for Learning, to provide open and accessible information
- ❖ regular national conferences and meetings.

Question 6. What support is needed?

Participants identified a range of support mechanisms to help them overcome the main obstacles to change, ie teachers' attitudes and curriculum pressures, including:

- ❖ the introduction of teaching thinking skills into initial teacher education
- ❖ creation of thinking skills working groups within schools
- ❖ time for teachers to reflect on their practices
- ❖ the creation of a support network for teachers
- ❖ funding to purchase temporary cover to enable teachers to undertake research, evaluation and development of resources
- ❖ continuous staff development at all levels
- ❖ a recognition and valuing of current practice and progress already achieved in this area
- ❖ the creation of an electronic website – a Scottish On-line Forum – for discussion and conferencing with money allocated to maintain the network
- ❖ more pilot programmes to identify which resources are most appropriate and offer the best value for money
- ❖ production of written reviews of packages/ resources currently in use
- ❖ good quality research to identify the impact teaching thinking skills has on pupils' ability
- ❖ development of standardised measures by professional researchers to facilitate action research by teachers.

Finally, while stressing that it is essential that teachers generate expertise within schools and avoid the trap of relying on commercially produced packages and tools to teach thinking skills, many wished to see the Scottish Executive take a role in the

promotion of thinking skills. They proposed that it should measure the effectiveness of different approaches/programmes. At the moment many different programmes are available commercially, but teachers fear they may infringe copyright legislation if they make multiple copies or adapt ideas. They would like the Scottish Executive to examine the evidence and recommend a way forward.

Question 7. What conclusions can be drawn?

The groups concluded that thinking skills can and should be taught, suggesting that:

- ❖ There is lots of activity in this area, and many examples of good practice in teaching thinking skills were cited throughout the day. Lots of enthusiasm and expertise have been demonstrated. This accumulated experience, which teachers have built up, must now be shared.
- ❖ The key question to be addressed is ‘how can children be taught to think more effectively?’ Teachers must be more explicit about what they are doing and why, if children are to develop in a climate of enquiry.
- ❖ Two enormous challenges facing the integration of thinking skills in schools are: pressures of the curriculum; and teachers’ attitudes towards new ways of working. Both need to be addressed.

Groups raised a number of specific points in their discussions including that:

- ❖ Thinking skills cannot be disassociated from the curriculum or how teachers deliver the curriculum. It should be an ‘intrinsic and untouchable’ part of the curriculum and not presented as another initiative to be implemented.
- ❖ The perception that children have fixed IQ, which cannot be developed, must be challenged. Individuals can and do blossom after leaving school.
- ❖ Teaching children to think effectively will impact on everything they do and helps them develop self-esteem and confidence.
- ❖ How to assess the impact of teaching thinking skills remains an outstanding problem. There was concern that too much assessment/evaluation could stifle children’s interest in thinking skills. Many felt that the only evaluation they needed was that the pupils enjoyed it.
- ❖ A possible conflict was identified between raising attainment and teaching thinking skills. Some argued that in their experience academic achievement rose when teachers utilised thinking skills.
- ❖ The management of the introduction of new approaches is crucial. Some cautioned against a ‘top-down’ approach during a period of extensive change accompanied by teacher exhaustion. The mandatory use of commercially produced packages should be avoided.
- ❖ It was considered to be crucial that links are made to what teachers are already doing. Developing thinking skills allows teachers to reflect on their practice and deliver the curriculum in a more focused way.
- ❖ It should be remembered that pupils respond to teachers, who respond to their needs and make explicit what they expect. Teachers cannot expect pupils to know what words such as ‘describe’ and ‘explain’ mean. These should be broken down and explained more.

Question 8. Where do we go from here?

The consensus was that teaching thinking skills is a very positive initiative and many hope it will be taken forward. As one group put it: ‘something very exciting is going on here and we [teachers] need to know more about it’. In order to achieve this, groups recommend a series of actions be taken.

Action points

(1) *Publicising the idea*

- ❖ All teachers should be persuaded that teaching thinking skills is not just ‘a passing phase, nor that anyone who doesn’t come on board is a dinosaur’. Many teachers have been implicitly including the concepts within their teaching already but need now to make the approaches explicit.

(2) *Basic approach*

- ❖ Implementation of thinking skills initiatives should be gradual and proceed in a critical/reflective way. ‘Start small’ is the key concept.
- ❖ The approach should be driven from the ground up, not a top down directive.
- ❖ Thinking skills must not be perceived as a discrete area. The whole curriculum is the context for teaching thinking skills – an interactive approach to thinking skills across the subject range is recommended.
- ❖ Thinking skills should be viewed as one way of raising achievement, but not the only way which all schools must adopt.
- ❖ Teaching thinking skills should be inter-linked with the concept of multiple intelligences, accelerated learning and the development of self-esteem.

(3) *Practical implementation*

- ❖ Within each school, a core group of committed/trained teachers should be identified who could affect change more readily than having ‘one-off’ presentations from brought in experts.
- ❖ Thinking skills should be included in whole school policies for Learning and Teaching, and then spread to policies for each curricular subject.
- ❖ A steering group of interested/experienced teachers should be formed to develop practical guidelines for use by teachers, but a complete revision of the curriculum guidelines by the Scottish Executive is not required.
- ❖ Research needs to identify how many of the specific thinking skills are common across the curriculum and transferable.

And finally, perhaps most importantly, teaching thinking skills should fit into what teachers already do as an integral part of good teaching; it should allow teachers to reflect on their practice, but must not be perceived as an ‘add-on’.

Summing Up and the Way Forward

Sam Galbraith, the Minister for Children and Education, thanked all those present for their contributions to developing thinking skills in schools. He reiterated his commitment to ensure that a report of the day's discussion was disseminated widely.

The following points were made by the discussion groups:

Research

- ❖ Good quality research and assessment and teaching methods and their impact are required.
- ❖ Action research groups in schools and education authorities should be encouraged.
- ❖ Teacher researchers should be supported by the development of standardised measures/instruments so the impact of teaching thinking skills can be systematically evaluated in the classroom.
- ❖ A nation-wide survey of the extent to which thinking skills have permeated learning and teaching in Scottish schools is required.

Benefits

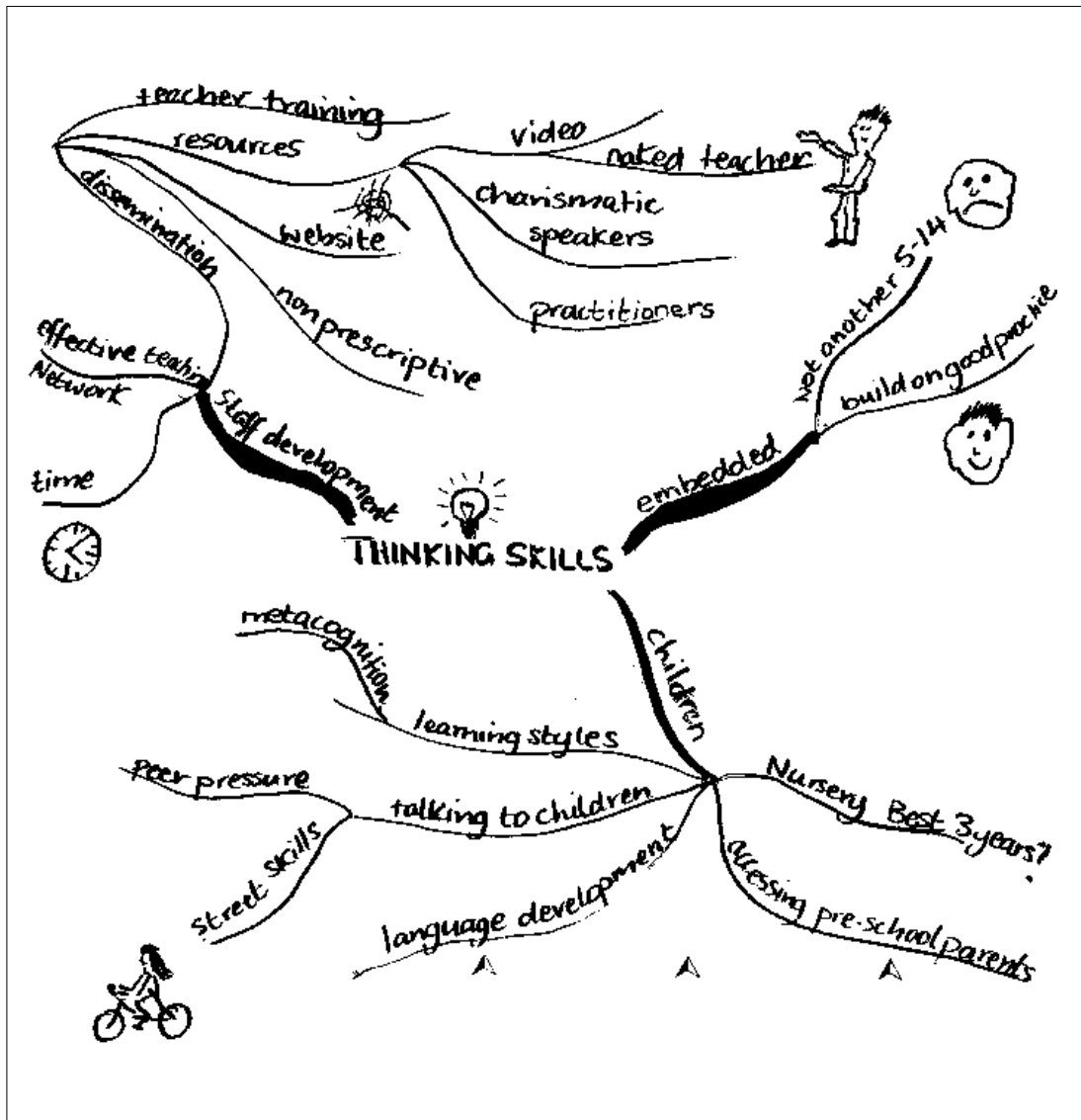
- ❖ Benefits include empowerment and enthusiasm of both staff and pupils.
- ❖ The methods articulate well with the concept of lifelong learning, both for academic purposes and for citizenship.
- ❖ There may be a conflict between the quality of children's learning and the focus on measurable targets: benefits may only be apparent in the long-term.

Sharing best practice

- ❖ Best practice must be shared and education authorities supported as they disseminate it within their schools.
- ❖ A network should be created to facilitate sharing of ideas and good practice.
- ❖ A steering group, composed of staff from schools and higher education institutions, should be formed. It can collate and disseminate exemplars of good practice.

In-service and pre-service training

- ❖ Quality training and time to implement it are required.
- ❖ A series of national and area conferences, both for in-service and pre-service training, should support implementation.
- ❖ Staff development across subject areas will encourage embedding of thinking skills within subjects.
- ❖ SEED should support training.



And finally

All agreed that they would welcome a chance to meet again to discuss results.

Appendix 1: Participants

Ms Fiona MacRae	Skene Square School	Aberdeen City
Mrs Jenny Watson	Hanover Street Primary School	Aberdeen City
Mr Ken McGowan	Fraserburgh Academy	Aberdeenshire
Ms Margaret Rattray	Rayne North Primary School	Aberdeenshire
Mrs Mary Logue	Carnoustie High School	Angus
Mrs Paula Wharton	Carlogie Primary School	Angus
Mrs Elaine Fraser	Rhu Primary School	Argyll and Bute
Mr Jim McNaught	Hermitage Academy	Argyll and Bute
Ms Carol Acutt	Alva Primary School	Clackmannanshire
Miss Mandi Carmichael	Abercromby Primary School	Clackmannanshire
Dr John Casey	St Joseph's College	Dumfries & Galloway
Miss Maureen Russell	Education Department (Secondment)	Dumfries & Galloway
Ms Maggie Clark	St Saviour's High School	Dundee City
Ms Anne Griffiths	Craigie High School	Dundee City
Ms Lizzie Heron	St Columba's Primary School	East Ayrshire
Mr James McBride	Cumnock Academy	East Ayrshire
Ms Sylvia Craig	St Joseph's Primary School	East Dunbartonshire
Mr Derek Milligan	Douglas Academy	East Dunbartonshire
Ms Jan Ainslie	Preston Lodge High School	East Lothian
Ms Shona Laurie	Longniddry Primary School	East Lothian
Ms Eileen Burnett	Auchenback Primary School	East Renfrewshire
Ms Mary Hallan	St Mark's Primary School	East Renfrewshire
Mr George Rubiensi	Craigroyston High School	Edinburgh
Mr Brian Speedy	Bruntsfield Primary Scholl	Edinburgh
Mrs Mary Caldwell	St Margaret's Primary School	Fife
Ms Tricia Egerton	Queen Anne High School	Fife
Ms Aileen Alexander-Bolton	Bellarmino Secondary School	Glasgow City
Mr Matthew Boyle	Knightswood Secondary School	Glasgow City
Ms Catherine Cumming	Merkinch Primary School	Highland
Mr Kevin Logan	Millburn Academy	Highland
Ms Marion MacDonald	Tain Royal Academy	Highland
Mr Rob Porteous	St George's School for Girls	Independent
Dr Charles Weedon	George Watson's College	Independent

Miss Colette Harkins	St Columba's High School	Inverclyde
Mrs Christine Mitchell	Wellington Academy	Inverclyde
Mr Mike Furneaux	St David's High School	Midlothian
Mr Tim Flood	Craigellachie Primary School	Moray
Ms Margaret Macfadyen	Applegrove Primary School	Moray
Mrs Fiona Hopkins	Fencedyke Primary School	North Ayrshire
Dr Alasdair Wham	Greenwood Academy	North Ayrshire
Ms Heather Forrest	Newmains Primary School	North Lanarkshire
Ms Agnes McGowan	Coltness High School	North Lanarkshire
Mr Trevor Baxter	Papdale House	Orkney Islands
Mrs Marilyn Richards	Kirkwall Grammar School	Orkney Islands
Ms Margaret Moran	Coupar Angus Primary School	Perth and Kinross
Ms Audrey Patterson	Cochrane Castle Primary School	Renfrewshire
Dr Jim Podmore	Castlehead High School	Renfrewshire
Mrs Anne Clark	Trinity Primary School	Scottish Borders
Mr Don Ledingham	Selkirk High School	Scottish Borders
Mrs Elizabeth Green	Dunrossness Primary School	Shetland Islands
Ms Helen Holdsworth	Belmont Academy	South Ayrshire
Ms Lesley Ann McGowan	Barassie Primary School	South Ayrshire
Mr Alex MacLeod	Earnock High School	South Lanarkshire
Ms Kate Reilly	Biggar High School	South Lanarkshire
Ms Stephanie Brown	Callander Primary School	Stirling
Mr Roy Pearson	Balfron High School	Stirling
Mrs Cathy Jeffrey	St Andrews High School	West Dunbartonshire
Mr Graham McKay	Dumbarton Academy	West Dunbartonshire
Mrs Alison Fox	Linlithgow Primary School	West Lothian
Mr Douglas Lambourne	Linlithgow Academy	West Lothian

Appendix 2: Discussion Group Brief

Discussion Group Brief

The aim of the two discussion sessions is to provide participants with an opportunity to discuss their views of the research findings in the light of their own practical experience, in small working groups. To focus the discussion we have asked groups to consider the following questions in each session:

1130–1230 *What are thinking skills?*

How can they be useful?

Can they be taught?

1345–1500 *What approaches have teachers taken?*

How can best practice be shared?

What support is needed?

What conclusions can we draw?

Where do we go from here?

The group should appoint a group leader to facilitate discussion and a scribe/rapporteur to take note of the discussion and provide feedback at the plenary session. The group should draw out three main issues from the two sessions and the group rapporteur should provide feedback on these using the attached overhead project film. Feedback should be kept as brief as possible to allow for a full discussion with the Minister.

A report of the day's discussion will be produced which will be sent to all participants and disseminated more widely to education authorities and the research community. The note of the group discussion and feedback and discussion at the plenary session will form the basis of this report. Discussion notes will be collected from each group at the end of the day.

Appendix 3: Starter Paper

Can Thinking Skills be Taught?

A paper for discussion

Valerie Wilson

Scottish Council for Research in Education

May 2000

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1. Introduction

The workings of one mind are not witnessable by other observers; its career is private. (Ryle, 1962, p.11)

In 1997, world authorities on intelligence including Feuerstein, Gardner and de Bono, met in Singapore for the Seventh International Conference on Thinking. As MacBeath (TESS, 20/6/97) reported all were quick to admit to ‘being only on the edge of understanding the inner magic of the thinking brain’. Exactly how to portray the human mind has preoccupied philosophers for centuries and more recently psychologists, educationalists and physiologists have contributed to the debate. Ryle (1962), quoted above, points to the inadequacies of earlier attempts to separate mind from body, especially the metaphors of outer and inner worlds. With the advent of information and communications technology, the brain has been compared to a computer which processes information in a logical, consistent and systematic way, but this analogy also is rejected by some educationalists. For example, Sylvester (quoted in MacBeath, 1997) prefers the metaphor of the brain as a jungle and argues that the learning environment of the classroom should mirror this by inviting challenge and discovery across different domains.

This, then, is the overarching context for this discussion paper:

- a long history of interest in the workings of the mind by members of disparate disciplines
- a dissatisfaction with the concept of intelligence as one stable measurable quality (Gardner, 1993)
- the possibility now with the development of magnetic resonance imaging of observing the brain ‘at work’
- renewed interest in the ways in which children think; and
- the belief that educationalists can improve children’s thinking with specific interventions.

This paper is presented as a series of questions for discussion in seven sections, of which this Introduction is the first.

In **Section 2**, the question for discussion is redefined and located within the context of theories of mind and how thinking and intelligence are portrayed.

Section 3 outlines the main approaches by which teachers have tried to teach thinking.

Section 4 presents the available evidence from published evaluations in both the UK and USA.

In **Section 5**, I indicate the conclusions which I think can be drawn from previous studies.

And **Section 6** addresses the question: ‘Where do we go from here?’

Finally in **Section 7** information on the databases searched is presented with readily available sources identified and the **End Notes** provide a short glossary.

2. The question: ‘Can thinking skills be taught?’

2.1 Background to the question

As Nisbet notes (1990) the concept of teaching thinking is not new. From the ancient Greeks onwards improving the intellect was perceived to be a prime aim of education. For Plato this entailed engaging in the Socratic dialogue and traditional logic. Some European countries, for example France, have traditionally included philosophy in the school curriculum. Others have argued that the teaching of Greek and Latin, to which mathematics and formal logic were added in the twentieth century, provide a training in rational thinking. In addition, the notion of inborn intelligence which dominated educational practice until the 1960s (Nisbet, 1990) was challenged by Vygotsky (1962) and others who developed a constructivist psychology predicated on learners as active creators of their own knowledge. By the end of the twentieth century this found expression in the development of ‘core’ or ‘key’ skills, such as problem-solving and decision-making, which some suggest can be embedded in primary and secondary school curricula.

2.2 What does science tell us about thinking?

It is impossible to summarise the findings from a number of disciplines within the constraints of this short paper: here I highlight a few significant points. Clearly, physiology (the science concerned with the functioning of human organs), psychology (the development of theories of mind and intelligence) and epistemology (the branch of philosophy which focuses on theories of knowledge), all impact on cognition/thinking. In particular cognitive psychology and epistemology have done much to clarify our understanding of the term ‘thinking’ and dispositions, such as attention and motivation, commonly associated with thinking. What then are the significant issues for teachers?

First, from biological psychology (Groves & Rebec, 1992) supported by psychiatry, neuroscience and pharmacology, a picture emerges of the brain and the processes associated with thinking. For the past 150 years scientists have attempted to localise functions within the human brain. To many scientists ‘the brain with its unappealing wrinkles and bland, gray color, hardly seemed alive’ (p.4). Gradually through clinical cases and laboratory experiments, evidence emerged that certain functions were located in specific area, for example speech in Broca’s area; while areas of the cerebrum, which occupies most of the top and front of the brain, are probably linked with less specific ‘higher mental activity’. A break through came in 1921 when a neuroanatomist described how although the nerve cells in the brain are packed close together, there is no physical connection between them. Techniques, such as positron emission tomography (PET scans) allowed scientists to monitor the blood flow to various parts of the cerebral cortex while subjects performed different

semantic tasks, such as hearing, seeing and speaking words. From these developments we can conclude that:

- Despite advances in knowledge, there is still much to learn about the working brain: in recognition of this fact the 1990s were designated the Decade of the Brain in the USA.
- Most of the growth in the human brain occurs in early childhood: by the age of six, the brain in most children is approximately 90% of its adult size. This implies that intervention, while the brain is still growing, may be more effective than waiting until the brain is fully developed.
- Although specific areas of the brain are associated with particular functions, large parts of the cerebrum – (commonly referred to as the ‘thinking cap’) appear to have a more general function. Some suggest that it functions in a similar way to extra memory in a computer and is brought into play to work more generally on higher level activities.
- There appears to be a two-way relationship between the working of the cerebrum and the tasks upon which it is engaged: while the connections within it are necessary for higher level activities to be undertaken, those connections also develop if stimulated.

Second, psychological theories provide a link between the physiology of the brain (described above) and thinking; here too developments have occurred. The first half of the twentieth century was dominated by a belief in innate general intelligence which was thought to be fixed and measurable. However, this interpretation has been discredited on two fronts: first, because IQ may not be stable over time (the Flynn Effect); and second, intelligence is thought to be more than a set of inherited abilities.

Continuing developments in cognitive psychology in the second half of the twentieth century have generated alternative explanations. Many teachers will have been trained in Colleges of Education heavily influenced by the work of Swiss psychologist Jean Piaget, who deduced his theories from detailed observation and children’s play. Put simply, Piaget claimed that all children pass through certain well-differentiated stages in their thinking and they do so in the same sequence no matter where they live. Each stage is characterised by particular behaviours and types of cognitive functioning (Siann & Ugwuegbu, 1988) and educational interventions should be appropriate to staged development.

Other constructivists stressed the active role of the learner in developing their own thinking. Bruner linked reasoning to the structuring of experiences, the development of schemata (by which learners give meaning to their experiences) and concept formation closely associated with language acquisition. Vygotsky (1962) stressed the cultural aspects of learning through active participation in collaboration with others while appropriately supported by the teacher (scaffolding). The differences are, as LaFrancois (1999) points out that ‘Piaget sees development as a sort of unfolding guided by internal tendencies:

Vygotsky sees development as a result of the child's interaction with other people (p.103).

Continuing this attack on the concept of a fixed general intelligence, Gardner (1983) made the case for at least seven (perhaps ten) different intelligences. His theory of multiple intelligence describes competencies in logical-mathematical, linguistic, musical, spatial, kinesthetic, interpersonal and intrapersonal domains. How these can be assessed remains problematic.

All of these developments have implications for teaching thinking skills. Some of which are:

- Brains are portrayed as under-used and, therefore, capable of further development by stimulation.
- Learning is seen as requiring active participation by learners who learn best in a social environment in which they give meaning to their own experiences.
- To build the necessary conceptual schemata, learners must be supported by teachers (Vygotsky's scaffolding) who gradually extend the learning challenges and provide appropriate feedback.

To summarise, cognitive psychology is concerned with the processes involved in thinking (ie knowing, remembering, perceiving, attending etc). The cognitive processing view of intelligence is, as LaFrancois (1999) suggests, a little like a box of tools that we use to play the game of cognition: we may not all have the same tools in our kit, but we can certainly improve how we use them. If cognition (thinking) is to be improved, then it is argued that teachers must make the learners' thinking processes *explicit* by employing methods which intervene directly on the 'thinking processes'. Part of this involves making learners aware of themselves as thinkers and how they process/create knowledge by 'learning how to learn' (metacognition). It is to these skills that we now turn.

2.3 What are thinking skills?

'Thinking skills' is an ambiguous term. Some argue that mental processes cannot accurately be described as skills in the same way one would describe a motor skill. There is also no consensus as to what should be included in the category of 'thinking skills'. Most writers assume that the term includes 'higher level' activities such as problem solving, decision making, critical thinking, logical reasoning and creative thinking (Nickerson, 1988). McGuinness (1999) points out that different researchers have produced different taxonomies of thinking. Most include some or all of the following:

- collecting information
- sorting information
- analysing information
- drawing conclusions from the information
- 'brainstorming' new ideas
- problem solving

- determining cause and effect
- evaluating options
- planning and setting goals
- monitoring progress
- decision making
- reflecting on one's own progress.

All are based upon the assumption that thinking (cognition) goes beyond the acquisition of knowledge (ie Ryle's, 1962, 'knowing that') and include the process(es) of knowing about thinking (metacognition) ie being able to reflect on the processes by which learners process information.

2.4 Why are thinking skills considered to be important?

Most countries are currently concerned with raising educational standards throughout the compulsory school years. But it is also argued, as the OECD (Maclure & Davies, 1987) points out, that the minimal requirements of schooling, ie mastery of the 'basics' (reading, writing, mathematics, science etc.), however excellently taught, are not sufficient to meet the demands of the labour market and active citizenship. It is now recognised that a broader range of competencies, redefined as 'higher order' thinking skills, is required because:

- The 'banking theory' of knowledge based upon rote learning has been discredited as it is recognised that individuals cannot 'store' sufficient knowledge in their memories for future use.
- Information is expanding at such a rate that individuals require transferable skills to allow them to address different problems in different contexts at different times throughout their lives.
- The complexity of modern jobs requires staff who demonstrate comprehension and judgement as participants in the generation of new knowledge or processes.
- Modern society assumes active citizenship which requires individuals to assimilate information from multiple sources, determine its veracity and make judgements.

Collectively, these present, as Resnick (1987) argues, 'a new challenge to develop educational programmes that assume that all individuals, not just an elite, can become competent thinkers' (p.7) because these competencies are now required of all. The cognitive approach suggests that learners must develop an awareness of themselves as thinkers and learners and practise the approaches and strategies for effective thinking.

2.5 The question redefined

In the light of this background, can thinking skills be taught? At one level, the question is far too general to be answered. As Ryle (1962) notes all human

beings, except those who have sustained specific injury or suffer from certain disabilities, demonstrate that they can think. It is, therefore, more helpful for this discussion if we redefine the question as: ‘Can children be taught to think more effectively?’ Accelerating cognition is a more meaningful and manageable topic for discussion. The aim of this paper is, therefore, to provide a ‘starter’ on this topic for discussion by an Education Forum of teachers and others. It seeks to:

- clarify the essential terms for discussion
- identify ways in which teachers have attempted to improve children’s thinking
- summarise the main findings from evaluations of teaching thinking skills; and
- indicate areas for future work.

3. What approaches have teachers taken?

In this section we consider the approaches which teachers have used to improve children’s thinking. Nisbet (1990) identifies two main approaches: one through specifically designed *programmes* and the other by *infusion* throughout the curriculum. McGuinness (1999), while agreeing with this general distinction between programmes and infusion, subdivides the latter. She points out that thinking skills can either be embedded in particular subjects eg in science, mathematics, history and geography, or more generally across the whole curriculum.

3.1 Specifically designed programmes

In 1990 Nisbet and Davies identified over 30 programmes of instruction on thinking skills but went on to suggest that there were in fact over a hundred in the USA alone.

3.1.1 Feuerstein’s Instrumental Enrichment

The best known example of a thinking skills programme is Feuerstein’s Instrumental Enrichment (IE) (Feuerstein, 1980) developed over 40 years ago for use with low-performing Israeli adolescents. It is a context-free cognitive intervention programme based upon the concept of ‘mediated learning’. An adult shows a learner specific methods for interpreting information and problem-solving. These become progressively more demanding through 14 instruments used over 2–3 years and introduce such concepts as syllogisms, favoured by the ancient Greeks.

3.1.2 Cognitive Research Trust (CoRT) – de Bono

Edward de Bono has written over fifty-six books on teaching thinking. His approach, especially such tools as ‘thinking hats’, are used in some schools and his programme developed through the Cognitive Research Trust is now accessible to schools. It consists of six sections, each of ten lessons including a teacher’s handbook and lesson notes for pupils. Each section covers one

aspect of de Bono's definition of thinking: breadth, organisation, interaction, creativity, information and feeling, and action. The lessons encourage learners to stop in the middle of a lesson and consider the views of other people involved in the situation. Its overall aim is to translate thinking which, he claims, is 'a pretty nebulous subject and needs anchoring with some focus of attention' (de Bono, 1991, p.187) by use of structured exercises.

3.1.3 The Somerset Thinking Skills Course

The Somerset Thinking Skills Course (Blagg *et al*, 1988) is a general thinking skills course. It consists of a handbook and several modules including the foundations of problem-solving, analysing and synthesising, propositions in space and time, predicting and deciding etc. The exercises may be used as a free-standing programme or integrated across the curriculum, usually in the upper primary school or with mixed ability groups in secondary schools. Unlike the Instrumental Enrichment Programme which presents abstract concepts, the Somerset course is pictorial and naturalistic.

3.1.4 Cognitive Acceleration through Science Education (CASE)

Cognitive Acceleration through Science Education (CASE), although set within the context of science, is a structured programme rather than an infused method. The programme consists of instructional materials for teachers, which present the concepts associated with formal operational thinking, and curriculum materials for use with pupils aged 11+ to 13+. Unlike philosophy, which makes use of deductive reasoning ie arguing from the given to the specific, CASE is based upon inductive reasoning. It encourages children to move from concrete examples to abstract generalisations, noting dissonance and promoting 'bridging' across other subject areas.

3.1.5 Philosophy for Children

Philosophy for Children is a network whose approach is associated with Lipman (1980) and has been further developed in the UK by Fisher (1995, 1998). Lipman believed that children were 'natural philosophers', constantly asking questions, considering alternatives and seeking answers. Teachers should exploit dialogue, using a Socratic framework, by modelling dialogue and structuring classroom activities in ways that promote its development. A number of novels, demonstrating children as problem-solvers, are recommended. Fisher has developed this approach further by focusing on questioning within classrooms, the ways in which teachers manage the process and develop a 'community of enquiry'.

3.2 Embedded/infused in the curriculum

As we identified earlier, thinking skills can be embedded/infused within specific subjects or across the curriculum more generally. Examples include:

3.2.1 Mathematics

Mathematics has long been associated with logical thinking (eg Russell and Whitehead's *Principia Mathematica* (1910). The teaching of mathematics in

schools has also developed. McGuinness (1999) points out that the trend is now to focus on the skills required to solve mathematical problems rather than the answers, *per se*, and to encourage 'situated learning' ie the use of maths in a real context.

3.2.2 *History*

The teaching of history has changed dramatically since the 1960s and represents a major shift away from teaching 'historical facts' to broad themes and understanding. Earlier work in England by the Schools' Council's History 13–16 Project, in which students were introduced to the concepts of historical evidence, sources and interpretation, focused on the nature of historical enquiry rather than the facts, *per se*. Curriculum and assessment of the subject in Scottish schools reflect these major changes. Therefore, thinking skills, ie collecting evidence, problem-solving, analysis and interpretation, should by now be well-embedded in the way teachers approach this subject area.

3.2.3 *Thinking through Geography*

This programme designed by David Leat of the University of Newcastle in partnership with geography teachers (Leat, 1998) identifies a list of 'big concepts' which the authors claim are necessary for an understanding of geography. These include: cause and effect, classification, planning, decision-making, location, inequality, development, systems. Twenty-four exemplar lessons were developed, each of which targets a concept. The lessons encourage concept development, the development of children's vocabulary for talking about thinking and the use of talk and group work for generating and evaluating alternative solutions. Teaching for transference is built into the programme.

3.2.4 *Activating Children's Thinking Skills (ACTS) (McGuinness et al, 1997).*

This project aimed to promote the development of thinking skills in ordinary classrooms in Northern Ireland at Key Stage 2. A Handbook was developed by McGuinness and a small group of teachers using a strategy similar to the one adopted by Leat (1998). Thinking diagrams or 'graphic organisers', eg for decision-making, were produced as an aid to making the steps in thinking explicit to learners.

4. **What does the research evidence tell us?**

In Section 3 above, I outlined some of the better-known examples of programmes and approaches to teaching thinking. I now consider published evidence from evaluations of these programmes.

4.1 **Specific programmes**

4.1.1 *Instrumental enrichment*

The evidence here is contradictory. Savell *et al* (1986) in a review of evaluations conclude that statistically significant differences had been reported between IE trained groups and control groups in four different countries (Israel, USA, Canada and Venezuela) in middle and lower social class groups

and in both mixed ability and educationally disadvantaged groups. Increases in non-verbal reasoning were reported but other effects, such as self-esteem, improved classroom behaviour, attainment tests, were inconsistent.

In contrast, Blagg (1991) in a two-year evaluation of IE intervention with 14 year-old low-achieving adolescents in four schools in Somerset reported no significant improvements in intelligence tests or tests of reading and mathematics in the experimental groups compared with the control groups. Cultural differences may explain some of the findings, but Blagg attributes them to the 'abstract' nature of the programme. This dissatisfaction led him to develop the Somerset Thinking Skills Course.

4.1.2 *Cognitive Research Trust (CoRT)*

De Bono (1991) discusses in detail the problems inherent in testing 'thinking' and, hence, in proving the efficacy of thinking skills programmes. It is now well-recognised that forms of assessment, which are presented as objective, may inadvertently be culturally biased. De Bono argues for teachers' assessment and presents evidence from a sample of small-scale experiments reporting 'idea-counting'. For example from tape recorded discussions of four CoRT trained primary school classes of children aged 10 to 11 and four control groups, he claims that much 'wider' ideas emerged from the CoRT groups.

4.1.3 *The Somerset Thinking Skills Course*

McGuinness (1999) reports that no large-scale evaluation of the effects of this course on subsequent intellectual performance is available (p.11). However, 14 controlled studies of the former Department of Employment funded *Thinking Skills at Work* programme, which was based upon the Somerset Course, were conducted by Blagg *et al*, (1993). They report that in 12 of the 14 studies significant benefits eg ability to recognise complex problems, plan and review work and demonstrate greater self-confidence for both trainees and trainers, were identified.

4.1.4 *Cognitive Development through Science Education (CASE)*

As most commentators note, longitudinal studies of the efficacy of teaching thinking are significantly absent. An exception is Adey and Shyer's (1993) two-year evaluation of CASE from 12 classes (four of 11-year-olds and eight of 12-year-olds) each of which was matched with a control class. Pupils were tested immediately after the programme and again one year later. Their subsequent GCSE results in Science, English and Mathematics were compared. It is claimed that CASE pupils' grades in GCSE Science were on average 1 grade above the control groups; smaller gains were recorded for Mathematics and English.

4.1.5 *Philosophy for children*

There is some evidence here from both the USA and the UK. Lipman (1980) reports the results of an evaluation conducted in the late 1970s by the

Educational Testing Service of Princeton, New Jersey of 200 students, aged 10–13 years. Students in two locations participated in the programme for two years. The results indicate improvements in intellectual performance, especially in reading and mathematics and also on creativity measures within the experimental group. In the UK, Fisher (1995) points out the difficulties in evaluating *Philosophy for Children* programmes because of its wide-ranging goals and the absence of appropriate evaluative dimensions on standardised tests. He suggests that gains are related to the quality of ideas generated, the skills of discussion and analysis and self-esteem – all of which are more difficult to measure on normative scales.

4.2 Infusion method

Evaluations of thinking skills embedded into subjects or across the curriculum are less well-documented. McGuinness (1999) suggests that small-scale teaching experiments are beginning to find their way into the literature: these are not necessarily accompanied by objective evaluations.

4.2.1 Mathematics

Schonenfield (1992, in McGuinness, 1999) reports findings from his programme for teaching mathematics to college students in which he models problem-solving through analysis, exploration and verification. He claims that a ‘before and after’ comparison of the problem-solving skills of students who attended his own courses compared with those students attending other courses indicate a marked difference. His students performed better not only on problems which he had covered during his course but also on different problems.

4.2.2 History

Results in this subject are again mixed. Peel (1967) suggests that pupils who had worked through the School’s Council’s History Project achieved higher levels of understanding of the nature of historical enquiry. In contrast, Wineburgh (1996) concludes that: ‘the key way stations, the cognitive bridges, along the path to higher understanding’ (p.429) followed by teachers and students on the History Project were not clarified.

4.2.3 Geography

No formal evaluation of this programme is reported.

4.3 Infused across the curriculum

4.3.1 Activating Children’s Thinking Skills (ACTS)

McGuinness, who developed this programme with teachers in Northern Ireland, reports teachers’ evaluation of the impact of ACTS on pupils and themselves. Overall their feedback is positive and teachers were very satisfied with the methodology. All teachers reported benefits in children’s thinking, reasoning powers and creativity and in their own concepts of thinking, review of schemes of work and effective planning. However, as McGuinness points out there are limitations to an evaluation of this type because it relies on

teachers' perceptions which were unrelated to learning outcomes in the classrooms.

5. What conclusions can we draw?

What conclusions can we draw from these projects discussed in Section 4 above.

5.1 The 'mind'

The 'rediscovery of the concept of mind', an interest in cognitive psychology linked with attempts to analyse the processes involved in acquiring the skills of learning, and a dissatisfaction with the concept of one measurable form of intelligence provide the overarching context for teaching thinking skills. An 'active' theory of 'learning how' rather than 'learning that' provides the theoretical basis (see Ryle, 1962).

5.2 A possible framework

Some suggest that there is now sufficient research and practical experience to form a framework for developing thinking skills. McGuinness (1999) proposes that a general framework for teaching thinking should include:

- the need to make thinking skills explicit in the curriculum
- adopt a coaching style to teach thinking
- operate within a metacognitive perspective
- develop collaborative learning in both face-to-face and computer-mediated learning
- encourage good thinking habits or general dispositions
- generalise the framework beyond a narrow focus on special skills to encompass the whole curriculum and concepts of 'thinking classrooms' and 'thinking schools'.

Others (Nisbet, 1990; Entwistle, 1987) prefer a hierarchical model, arguing that schools should teach both specific skills and also strategies:

- *Specific Skills* – skills specific to subjects or general skills specific to tasks shared in related subjects
- *Learning Strategies* – generalised procedures or sequences
- *Approaches to learning* – self-regulated learning.

5.3 Two or three approaches?

Researchers are divided on the number of approaches to teaching thinking skills: Nisbet suggests two, while McGuinness proposes three. All, however, distinguish between *specific programmes* on the one hand, and an approach which is *embedded* in either subjects or across the curriculum on the other. Transference beyond the specific context remains problematic.

5.4 Outcomes

Evaluation studies are inconclusive. A number purport to link successful outcomes with teaching thinking skills but it is difficult to control for the influence of other variables. McGuinness (1999) points out that the most successful interventions are associated with a 'strong theoretical underpinning, well-designed and contextualised materials, explicit pedagogy and teacher support' (p.1). However, 'scaling-up' and generalising from findings emerging from small evaluation studies have still to be overcome. Problems of mediation, transference and bridging remain.

5.5 What is achievable?

Most research has been conducted under optimal learning conditions. Problems of embedding the approach into everyday classroom practice, based upon what the average teacher can achieve rather than the expert practitioner working in good conditions with well-motivated pupils, remains to be demonstrated. Therefore, teacher development opportunities and support are required if classroom practices are to change.

5.6 Information and communications technology

Information and communication technologies provide logical frameworks which some argue will enhance children's thinking, either through individual interactions with computers and multimedia or opportunities for collaborative learning through networks. More evidence on computer/learner interaction and collaborative learning is still required.

Finally, there appears to have been a general shift from discussing 'thinking children', through 'thinking classrooms' to 'thinking schools'. These may be realisable aims for an education system, or alternatively, simply more metaphors for teachers to decode and translate into practice. McGuinness (1999), while accepting the limitations of available evidence, comes down strongly on the side of the value of teaching thinking skills. My own conclusions are more cautious. Given the paucity of evidence, it would, perhaps, be fairer to conclude that 'the jury is still out' on this particular issue.

6. Where do we go from here?

As Nisbet (1984) points out, encouraging metacognition (see end notes), accelerated learning or thinking skills is still an unfinished story. Fundamental research on the nature of intelligence and its stability over time will continue (see Appendix 4 for a report on the SCRE data by Deary *et al*, in press). There are, however, a series of further issues on which teachers could profitably reflect, bringing both their professional expertise and practical understanding. These include:

6.1 Methods

Which is the most effective method for improving children's thinking skills: the use of *special programmes*, an *infusion approach* within either individual

subjects or across the curriculum or a combination of both? Both have drawbacks and further evidence of outcomes, especially from ‘scaled-up’ examples, is required.

6.2 Curriculum

Can a curriculum, with core thinking/problem-solving skills be constructed without overloading both teachers and learners? Evidence from the Wales Curriculum 2000 (Wilson *et al*, 1999) indicate that teachers believe it is easier to embed ‘core skills’ within certain areas than in others, eg within the primary curriculum and history as opposed to modern languages in the secondary school curriculum. What is the experience of teachers in Scottish schools?

6.3 Stages

Which are the most appropriate stages for teachers to introduce metacognitive development: pre-school, primary, secondary, further, higher or adult continuing? So far adult continuing with its reliance on ‘andragogy’ as a theory of learning, has led the way. Are there lessons to be learnt here?

6.4 Information and communications technology

The use of new technology within schools offers the possibility to develop accelerated thinking. As yet we know little about computer/child interaction or the mediating role of the teacher. This is an area where the Economic and Social Research Council’s (ESRC) programme on Teaching and Learning should yield further evidence.

6.5 Teaching materials

Are there sufficient high quality teaching/learning materials for use in Scottish schools? Currently SCCC is developing materials for core skills for Higher Still. Do materials need to be developed which articulate with 5–14 and Standard Grade or can interested teachers adapt materials from elsewhere?

6.6 Teacher support

If teachers are to be encouraged to develop children’s thinking skills explicitly, what support do they require? Is this topic more appropriately located within initial training or at post-experience levels? Are other forms of support required?

7. Selected bibliography

This bibliography is selective. Three databases were searched: ERSDAT, the British Education Index and ERIC. Key words *teaching thinking*, *teaching philosophy*, *teaching cognition and metacognition* were used. Only 2 items were identified in ERSDAT. The British Education Index from 1976-99 yielded 14 references for *teaching thinking*; 1 each for *teaching philosophy* and *teaching cognition*, and 119 for *metacognition*. ERIC over a shorter period, 1983–99, provided 97 references for *teaching thinking*, 98 for *teaching philosophy* and 2,274 for *metacognition*. An additional search using *brain* as

a keyword was conducted. Only 33 references were identified in the British Educational Index, the latest dated 1996, and 2,260 from ERIC, most on brain damage. Most references are American and few comply with Slavin's (1984) conventions of best evidence: many are resource books and manuals for practitioners' use rather than evaluations. A selected bibliography of sources is listed below:

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End notes

- 1 **Constructivists** is a general label for psychologists who claim that meaningful knowledge and information are constructed by the learner, and hence, teaching and learning should be highly learner-centred. This is often contrasted with direct instruction as a method of teaching and learning.
- 2 **Cognition** is the process by which humans acquire knowledge. It includes thinking, perceiving, attending and understanding.
- 3 **Intelligence Quotient (IQ)** is a way of measuring general ability by multiplying the ratio of a child's mental to chronological age by 100 and comparing the score to comparable groups of people. The Stanford-Binet tests are the best known examples of measures of intelligence for verbal reasoning, quantitative reasoning, abstract/visual reasoning and short-term memory: collectively they provide a composite score which is generally interpreted as an IQ score.
- 4 **Flynn Effect:** Flynn (see LeFrancois, 1999) examined IQ data from 14 countries spanning 50 years and identified gains over time. The implications for teachers are that teaching and learning (or other factors) may be contributing to the general rise in IQs over generations.
- 5 **Scaffolding** is the term used by Vygotsky to describe various types of support that teachers or carers need to provide for children to enable them to learn. It may include verbal assistance, questioning, suggestions and directions, all aimed at extending the child's activities into an area (of proximal growth) in which the child cannot accomplish the activities alone.
- 6 **Metacognition** is a higher level activity which is defined as knowledge about cognition/ knowing. It requires learners to develop the ability to reflect on their own ways of acquiring knowledge ie learning to learn.
- 7 **Scottish Mental Survey** data are the results of IQ type tests of every 11-year-old in school on 11 June, 1932 and 1947 (87,498 and 70,805 children respectively). They are currently being reanalysed by a multidisciplinary team from the Universities of Edinburgh and Aberdeen and SCRE, led by Professor Ian Deary. (See TES, 3/3/2000 in Appendix 4.)
- 8 **Andragogy** is a theory of learning based upon self-direction and autonomy of the learner.
- 9 **Economic and Social Research Council (ESRC)** is an agency which allocates Government funding for research in the social sciences throughout the UK. A current priority area is teaching and learning to which £12.5 million has been allocated. Researchers compete for research funding.
- 10 **ERSDAT** is a database of educational research in Scotland maintained by SCRE and funded by SEED.
- 11 **The British Education Index** is the major indexing service of educational journals in the UK.
- 12 **ERIC** is the major US indexing service of educational articles, conference papers and reports.

Appendix 4: Follow-up to the 1932 Scottish Mental Survey

6' News

FRI, MARCH 2001

Tests may show the way to a happy and healthy life

By Willie Pickard

NATIONAL testing has a value — 60 years on, a unique set of records shows that 11-year-olds tested in 1932 have not lost their mental abilities in old age.

The results were discussed at the Edinburgh offices of the Scottish Council for Research in Education and have been used by researchers into the effects of ageing. Thousands of volunteers have been tested and resulted on the same questions in Aberdeen and Edinburgh.

They scored a lot better than they did at 11, and differences in mental ability remain constant throughout life. In one of the Edinburgh rooms a "pupil" recalled a girl's first kiss.

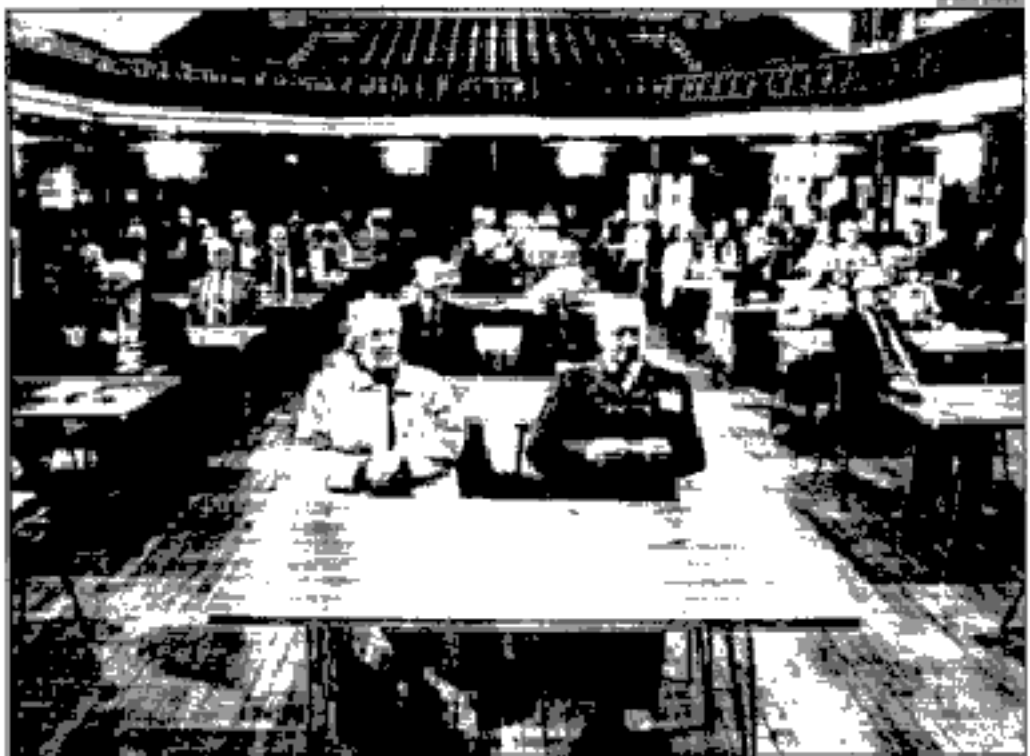
The 1932 data on 67,498 children, which are still being compared with the results of another national test of 70,500 11-year-olds in 1947, were obtained by a distinguished trio of scientists: Dr John Derry, Edinburgh University's first psychology professor, Sir Geoffrey Thomson, professor of education and a world pioneer in measuring intelligence, and Robert Rank, the research council's director.

On Monday, June 4, 1932, all had a boy proposition of the nation's 11-year-olds and a girl based on Sir Geoffrey's Nancy House Tests as used in the English 11-plus examinations.

John Derry, professor of differential psychology at Edinburgh University, who has looked at the results from the voluntary surveys, says that the common view of old age as a period of mental decline is mistaken.

"Change would be a better description," Professor Derry says. "We want to find out what it is in these experiments, involvement in society and so on that leads some people to maintain development with age rather than declining."

Putting my fingers that maintain thinking skills was often



Ready for the test: the same conditions and time limits applied in Aberdeen's Music Hall as in the classrooms of 1932

what leads to a generally healthy old age, he says. The research council data are unique in allowing researchers to measure not just how older people perform but how they measure against their performance as children.

The names of Professor Derry and Laurence Whalley, professor of mental health at Aberdeen University, is changed in regulation throughout the visit except by tracking down the H.S. results.

Professor Derry accepts that the elderly volunteers do not

recall from a very representative sample of the original 67,000. Many took the initiative in responding to advertisements and old boys show a better ability than of surviving into old age. But the SCRE's information, which is being computerised, is richer than other international studies such as a Canadian university's follow-up on men on returns to the front in the Second World War.

Volunteer Whalley, the research council's director, says: "It is exciting to find strength these black-

board legends. In my experience ways in which the results are revealed by school and by authority and to consider the cooperation which would have existed then across members, education authorities and the organising committee in SCRE."

She adds: "This part of our educational history is not just an archive," in that the 1932 survey results give "a unique opportunity which few other countries possess. We hope we will all learn from the data by working on interdisciplinary teams from

psychology and public health and that our findings will contribute to our understanding of complex social issues."

The Scottish Executive has given STOR to the research project. Professor Derry leads the Inter-Medical Research Council will support a follow-up of the 1947 data because "these people are an interesting group".

He adds: "They are in their 60s, and retirement is now seen as an active period, part of the lifelong learning which is emphasised by governments."