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FROM THINKING SKILLS TO THINKING CLASSROOMS

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In October 1998 The Department for Education and Employment commissioned a review and evaluation of research into thinking skills and related areas. The purpose of the review was to analyse what is currently understood by the term "thinking skills" and their role in the learning process; to identify approaches to developing children's thinking and to evaluate their effectiveness; to consider how teachers might be able to integrate thinking skills into their teaching both within subject areas and across the curriculum; to identify the role of ICT in promoting a positive approach to thinking skills; and to evaluate the general direction of research and how it might translate into classroom practice.

Key Conclusions

- **A framework for developing thinking skills**. Sufficient research and practice has accumulated to identify core concepts in a framework for developing thinking skills. Although theoretical emphases can differ, the general framework now includes; the need to make thinking skills explicit in a curriculum; teaching thinking through a form of coaching; taking a metacognitive perspective; collaborative learning (including computer-mediated learning); creating dispositions and habits of good thinking; generalising the framework beyond a narrow focus on skills to include thinking curricula, thinking classrooms and thinking schools. Considerable evaluation work remains to be done in order to link the critical features of the framework to learning outcomes in different contexts.

- **Models for delivering thinking skills**. Three models for delivering thinking skills were identified. Interventions can be directed towards enhancing general thinking skills through structured programmes which are additional to the normal curriculum; they can target subject-specific learning such as science, mathematics, geography; or they can be infused across the curriculum by systematically identifying opportunities within the normal curriculum for thinking skills development. Whatever approach is adopted, the methodology must ensure that the learning transfers beyond the context in which it occurs

- **Evaluation.** Several classroom evaluation studies have successfully linked teaching thinking methodologies with learning outcomes both in the short term and the longer term. Not all interventions are equally successful. The more successful approaches tend to have a strong theoretical underpinning, well-designed and contextualised materials, explicit pedagogy and good teacher support.

- **Information and communication technologies** can be linked to the thinking skills framework in several ways and provide a tool for enhancing children's understanding and powers of reasoning through exploratory environments/microworlds, multi-media and hypermedia. Networked communication (local and wide area) provide special opportunities for collaborative learning. Considerable evaluation remains to be completed on learning outcomes for both individual and whole class learning.

- **Teacher Development.** Much of the research on the efficacy of teaching thinking has been conducted under optimal learning conditions. Problems with scaling up and transferring the effects to everyday classrooms have been identified. In particular, the more successful interventions have been characterised by explicit models of teacher development and teacher support.

Core Concepts in a Framework for Developing Thinking Skills

Most attempts to teach thinking are based on some formal analysis of the nature of thinking, but what they are all trying to achieve, irrespective of their precise theoretical foundations, is to develop the person's thinking to a qualitatively higher level. Core concepts have emerged.

- Developing thinking skills is supported by theories of cognition which see learners as active creators of their knowledge and frameworks of interpretation. Learning is about searching out meaning and imposing structure.

- Focusing on thinking skills in the classroom is important because it supports active cognitive processing which makes for better learning. It equips pupils to go beyond the information given, to deal systematically yet flexibly with novel problems and situations, to adopt a critical attitude to information and argument as well as to communicate effectively.

- There is a need to be explicit about what we mean by better forms of thinking and of educating directly for thinking. If students are to become better thinkers - to learn meaningfully, to think flexibly and to make reasoned judgements - then they must be taught explicitly how to do it.

- Several taxonomies of thinking are available. They include some reference to sequencing and sorting, classifying, comparing, making predictions, relating cause and effect, drawing conclusions, generating new ideas, problem solving, testing solutions, making decisions and so on. Some approaches identify multiple intelligences for enhancement - linguistic, logical-mathematical, musical, kinesthetic.

- High quality thinking is emphasised in most approaches and there is a need to design learning tasks which are not routine but have a degree of open-endedness and uncertainty to permit learners to impose meaning or to make judgements or to produce multiple solutions.

- It is important to give learners the time and opportunity to talk about thinking processes, to make their own thought processes more explicit, to reflect on their strategies and thus gain more self-control. Acquiring and using metacognitive skills has emerged as a powerful idea for promoting a thinking skills curriculum.

- Children bring their own conceptions (and misconceptions) into the classroom. New knowledge and alternative strategies for thinking are socially constructed in the classroom not only through informed teacher instruction but through practical activities, dialogue, reflection and discussion with peers and adults. Such socially mediated activities need to be carefully designed from a thinking skills perspective.

- Developing better thinking and reasoning skills may have as much to do with creating dispositions for good thinking as it has to do with acquiring specific skills and strategies. For this reason classrooms need to have open-minded attitudes about the nature of knowledge and thinking and to create an educational atmosphere where talking about thinking - questioning, predicting, contradicting, doubting - is not only tolerated but actively pursued.

- Increasingly it is recognised that developing thinking skills has implications not only for pupils' thinking but for teacher development and teacher thinking as well as for the ethos of schools as learning communities.

Examples of Approaches to Developing Thinking Skills

A distinction can be drawn between approaches which target general thinking skills (and are usually timetabled separately) and those that are subject or domain specific, for example, thinking in science, mathematics, physics, history. A third way is to adopt an across-the-curriculum approach by infusing thinking skills across all lessons.

Some approaches are highly developed, with commercially produced curriculum materials, staff training opportunities, and full-scale evaluations in classroom settings. Others are at the level of small scale research-driven teaching experiments conducted in optimal settings. Research and practice in developing thinking skills is now world wide.

- One of the best known general thinking skills programme world wide is Feuerstein's Instrumental Enrichment (IE) which was developed some 40 years ago (Feuerstein et al., 1980). Remedial in its outlook and initially intended for slow learning adolescents, it is now used across wider age groups and abilities. Extensive evaluations of IE show positive effects primarily on measures of non-verbal reasoning. Studies also show the importance of training for teachers, substantial exposure to IE materials (1-2

years) and IE taught in conjunction with topics of interest and importance to the students.

- The Somerset Thinking Skills Course is a UK elaboration of the IE approach and was designed as a result of dissatisfactions with IE materials and a failure to demonstrate positive effects of the method in a UK study (Blagg, 1991). This work is now extended into occupational settings and a set of materials, Thinking Skills at Work, is available. Evaluations show positive effects on a range of cognitive and related outcomes.

- Martin Lipman's Philosophy for Children (Lipman et al., 1980) is widely used in the UK and is associated with Robert Fisher who has written extensively about teaching thinking in primary classrooms (Fisher, 1998). The approach can be used across the curriculum particularly in the context of social and moral education where the philosophical emphasis on questions and questioning is important. Evaluations show positive effects along many dimensions other than standard achievement tests, for example, in terms of the quality of children's discussion and argumentative skills, ability to formulate questions, self-esteem, and so on.

- One of the most successful and well-evaluated programmes is CASE (Cognitive Acceleration through Science Education) which is directed towards scientific-type thinking for 11-14 years. CASE succeeded in raising pupils' grades in GCSE examinations (on average 1 grade) two to three years after the programme had been completed (Adey & Shayer, 1994). CAME (Cognitive Acceleration through Mathematics Education) is now a parallel programme targeting mathematical thinking. The Nuffield Primary Science Project, which grew out of the SPACE project (Science Process and Concept Exploration Project), uses techniques which help children develop a more "scientific" understanding of topics such as electricity, light, sound, energy.

- An innovative curriculum development project called Thinking through Geography (Leat, 1998) is designed around a list of "big" concepts which are important for geography teaching and learning at post-primary level. Evaluation work on learning outcomes is on-going.

- An example of the infusion methodology for developing thinking skills can be seen in the ACTS project (Activating Children's Thinking Skills) for upper primary level (McGuinness et a", 1997). Modelled on Swartz & Parks (1994) infusion approach in the US, teachers trained in ACTS infusion methodology have identified opportunities for developing a range of thinking

skills within the Northern Ireland curriculum at Key Stage 2 and have scripted lessons.

Teaching from a thinking skills perspective is particularly evident in the sciences and mathematics and, increasingly so, in history and geography. There is scope for considerably more systematic work within subject areas in order to link together existing research which is not so readily identified as "thinking skills" (e.g., in the creative arts, moral and social development) as well as commonalities and differences between thinking skills as they are exercised in disciplinary contexts.

The Role of ICT in Developing Thinking

The way in which technology-based applications are used and assessed in classrooms is mediated by advances in learning. In early examples of computer-assisted learning, the pedagogy was largely drill and practice of skills such as arithmetic facts, word recognition and spelling. Recent innovations are more consistent with a thinking skills approach.

- Interactive exploratory environments or microworlds allow students to direct their own learning through discovery and guided discovery processes. They help make thinking more explicit and enable pupils to hypothesise and experiment with immediate feedback and to facilitate discussion and reflection with peers. Software applications are available such as Geometry Sketchpad for exploring geometric relationships, STELLA for systems thinking, ThinkerTools for teaching the laws of force and motion.

- Video and multi-media technology are also used to create exploratory environments. They permit students to form rich images of problem situations in multiple modalities and prompt alternative perspectives.

- Local and networked communication (databases, email, WWW) provide unique opportunities for collaborative learning. Several examples of the positive impact of networked classrooms on pupils' thinking and learning have been documented (Computer Supported Intentional Learning Environments (CSILE), Technology Intentional Learning Environments (TILES).

Extensive experimentation and evaluation is required before the full impact of this new technology on learning and thinking can be assessed.

Teacher Development and Support

Many writers comment on the importance of teacher preparation and teacher support for the successful implementation of thinking skills approaches.

- Teaching thinking, by whatever approach, demands that teachers, pupils and technologies interact with one another in certain ways. Classrooms which are characterised by talk and discussion and by questions and questioning need to be managed and orchestrated yet remain clearly focused on learning objectives. Teachers' existing craft knowledge can be threatened as they struggle to implement this more constructivist environment.

- Good practice points to the need for in-service education to include networks of teachers, peer coaching and a thorough exploration of evidence in relation to children's learning.

Demonstrating the efficacy of thinking skills approaches in research-driven learning conditions is not sufficient. Transplanting the effects into ordinary classrooms needs careful monitoring and support.

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