Introduction

This handbook is about thinking. More specifically, it is about theoretical frameworks and classificatory systems developed since the Second World War to help educators understand the processes and products of thinking and learning. By setting out the ideas and beliefs of various system builders it raises questions about human nature and the nature of knowledge. However, it is far from comprehensive in its treatment of philosophical issues, since the starting point for our work was a brief from the Learning and Skills Research Centre (LSRC), based in London, to evaluate thinking skills taxonomies which may be relevant in post-16 education and training. Our main purpose is practical, so we are more interested in how frameworks can be used than in theoretical elegance.

Everyone involved in education and training needs to talk about thinking and learning. Frameworks for thinking can provide shared understandings which can help improve the quality of instructional design, course and lesson planning, teaching, learning and assessment. We therefore believe that this handbook will be useful for practitioners, students and academics as well as for policy-makers and others wanting to find out more about certain frameworks.

Here, as in the published report of our work for the LSRC (Moseley et al., 2004),[1] we include frameworks and models as well as taxonomies, and are just as interested in school education as the post-16 sector. However, by focusing on analyses of thinking and learning which are concerned with structure as well as function, we largely

[1] Copies of this report can be downloaded from: http://www.lsda.org.uk/pubs/dbaseout/download.asp?code=1541

exclude holistic and narrative accounts of thinking, many of which are critical of attempts to impose categories on organic and dynamic experiences.

Our interests and the concerns of many of the authors represented here extend well beyond the cognitive domain, since people think and learn in social and cultural contexts and experience an interplay of cognitive, emotional, motivational and social energies. Education is widely seen as being about social and emotional learning as well as the acquisition of academic knowledge and skills. Illeris (2004) located learning theorists in a triangular space defined by three dimensions of learning (cognitive, emotional and social). However, it is noticeable that few of those in the social corner have put forward ways of classifying thinking. Consequently, most of the frameworks outlined and evaluated in this handbook have a cognitive and affective emphasis. One (that of Pintrich, 2000) is solely concerned with motivation, dealing with processes and strategies where thinking, feeling and will (conation) are intertwined.

Selection of frameworks

We began by conducting a comprehensive and systematic literature search of electronic and paper-based sources, initially confining ourselves to the term 'taxonomy', but later extending this to 'framework' and 'model'. Over 400 articles and books were identified as relevant and we read most of these. We also found a large number of useful websites, many of which are gateways to other sources. We included 55 thinking skills frameworks in our LSRC report, with evaluations of 35 of these. In the present handbook, as in our LSRC research, we have excluded unsystematic ways of describing thinking skills, including lists with no organising principles. We have also excluded frameworks which add little to existing formulations. Decisions as to what to include in the handbook in order to extend its age coverage downwards were made after discussion within the writing team. We have ended up with 41 individual frameworks, plus a composite evaluation of theories of executive function.

Description and evaluation of individual frameworks

After describing the main features of each framework, we evaluate it in terms of purpose(s) and actual and potential use(s), applying a consistent set of criteria. We deal with each framework under three main headings: *description and intended use*, *evaluation,* and *summary* (in tabular form).

The following aspects are taken into account:

Description and intended use
nature and function: taxonomy/framework/model/map/list
the domains and/or sub-domains addressed
the principle or principles used in constructing the framework
structural complexity and level of detail
broad categories covered
thinking skill categories
thinking skill elements
stated purpose

Evaluation
how well the domains and/or sub-domains are covered
extent to which categories overlap
overall coherence
distinctiveness
justification for choice of underlying principles
explanatory power
compatibility with similar systems
consistency with well-supported theories
pedagogical stance (if any)
values: explicit/non-explicit; descriptive/prescriptive
clarity of formulation
accessibility for teachers and learners

Relevance for teachers and learning
actual and potential areas of application
implications for understanding teaching and learning

implications for practice
actual and potential use in research.

As we became familiar with an increasing number of frameworks, we noted many common features regarding scope and structure and asked ourselves whether it might be possible to formulate an integrated 'meta-model' against which we could compare the scope and structure of each framework. We agreed on the following set of broad categories, and use them in our summary tables:

- self-engagement
- reflective thinking
- productive thinking
- building understanding
- information gathering

These broad categories are not meant to be interpreted as a hierarchy of levels, but are seen as interactive systemic processes (Moseley et al., 2004, 2005).

How to use this handbook

Mode of use will depend on purpose. Many readers will be interested in a limited number of theorists and will use the handbook for reference purposes, perhaps in connection with a student assignment. Others will be interested in a tradition of thought or practice, such as critical thinking or instructional design. They can learn about a 'family' of frameworks, presented in chronological order in one of the four main content chapters (Chapters 3–6).

If the reader's purpose is to select one or more frameworks for professional use, they would be well advised to read Chapters 1 and 7 in preparation for the task and to consider the relevance for a particular subject area of theoretical issues about the psychology of thinking and learning (covered in Chapter 5). A quick reading of a selection of summary tables will then help the reader to choose a small number of frameworks for more detailed study, before making a final choice.

The first two chapters are helpful for people who value clarity in the use of terms and wish to make analytic comparisons between

frameworks. Chapter 2 contains some illustrations of how this may be done, encouraging the reader to go beyond the present text and work at some depth. With the same end in view, each of the 'family group' chapters ends with a section raising issues for further investigation. These sections may also be used as advance organisers for critical reading.

The handbook is an excellent resource for comparing and contrasting theories and models. We anticipate that at college level teachers will often want to challenge students to identify the strengths and weaknesses of contrasting frameworks in relation to a subject area or field of study. For example, medical students might be asked how far King and Kitchener's model of reflective judgment and Vermunt and Verloop's categorisation of learning activities illuminate their understanding of problem-based learning.

Teachers and other professionals who wish to acquaint themselves with a wider range of disciplinary approaches to the study of teaching and learning will find this a useful introductory text. The first chapter provides an overview of the field and a number of all-embracing frameworks are described in Chapter 6. Chapter 3 has a mainly educational emphasis, while philosophical frameworks predominate in Chapter 4 and psychological frameworks in Chapter 5.

A superficial flicking through the handbook would equate with a 'pre-structural' understanding, in SOLO taxonomy terms (Biggs and Collis, 1982). Reading about one or more frameworks without relating them to each other or to one's own experience would be to gain knowledge at the 'unistructural' level, whereas 'multistructural' understanding would be to notice a number of similarities and differences without fully grasping their significance. The authors hope that readers will seek to develop new understandings of ideas, values and practices within their fields of enquiry and that by critically engaging with the text and consulting original sources a deeper appreciation of trans-disciplinary themes will result.

Overview of what follows

Chapter 1 The nature of thinking and thinking skills

This introductory chapter provides an overview in which theories, models, and concepts underpinning cognitive education are described

and discussed. It reflects the current emphasis upon the strategic and self-regulatory nature of learning and provides detailed accounts of theoretical and practitioner use of such terms as metacognition, critical thinking, creative thinking and self-regulation. Other terms describing cognitive processes (e.g. analysis, synthesis, problem-solving, information-processing) are discussed or defined as necessary.

Chapter 2 Lists, inventories, groups, taxonomies and frameworks

This chapter explains the nature and function of ways of organising fields of study, with special attention to taxonomies. It then demonstrates their application in different fields, including three examples of frameworks which deal with aspects of thinking.

Chapter 3 Frameworks dealing with instructional design

This family group includes conceptions by Bloom, Anderson and Krathwohl, Biggs and Collis, Gagné and Feuerstein. All authors seek to create a structured learning environment, whether the emphasis is on content or process, knowledge acquisition or creativity.

Chapter 4 Frameworks dealing with productive thinking

Here we focus upon frameworks used for understanding critical and 'productive' thinking. Conceptions by de Bono, Halpern, Ennis, Lipman and Paul are included, as well as the TRIZ theory of inventive problem-solving.

Chapter 5 Frameworks dealing with cognitive structure and/or development

This group includes models of cognitive structure and/or cognitive development. As a 'family' it is relatively diverse and includes different approaches to analysing the concept of intelligence. It includes well-established theories such as those of Piaget, Guilford and Gardner, as well as a recent synthesis of components of self-regulation by Pintrich.

Chapter 6 Seven 'all-embracing' frameworks

Members of this family group are relatively all-embracing in scope, covering personality, thought and learning. Included here is Wallace

and Adams' 'Thinking Actively in a Social Context' framework as well as some recent conceptions such as Vermunt and Verloop's categorisation of learning activities, Marzano's taxonomy of educational objectives and Sternberg's model of abilities as developing expertise.

Chapter 7 Moving from understanding to productive thinking: implications for practice

This chapter examines how various taxonomies can inform differing forms of cognitive education. It will explain the particular emphases of some of those that the authors deem most relevant for different types of thinking programme. Finally, we outline the value to practitioners of a four-category framework (information-gathering, basic understanding, productive thinking, strategic management/reflective thinking) that has arisen from our evaluation.

Without downplaying the importance of unconscious and social processes, we believe that thinking skills approaches focus attention on self-aware goal-directed thinking, in which there is strategic management of attention and working memory, supported by various 'habits of mind', including critical reflection. The goals of thinking and learning may be concerned with information-gathering, with building understanding, with thinking that generates productive outcomes, or with dynamic combinations of all three.

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The nature of thinking and thinking skills

Perspectives on thinking

To be genuinely thoughtful, we must be willing to sustain and protract that state of doubt which is the stimulus to thorough enquiry, so as not to accept an idea or make a positive assertion of a belief until justifying reasons have been found.

Dewey, 1933, p. 16.

The aim of this book is to summarise and evaluate a number of systematic approaches to describing thinking and its relation to learning and teaching which have been developed over the last 50 years or so. We believe that each of these frameworks and taxonomies have value in attempting to describe aspects of thinking. The purpose of this collection is therefore to provide a resource for teachers, learners and researchers in order to make explicit a vocabulary with which to describe aspects of thinking which are relevant across a range of situations and contexts. Without a vocabulary to describe aspects of thinking that we believe to be teachable it is hard to develop teaching approaches or pedagogies that are effective. As a learner it is difficult to understand and make connections with what we have learned at different times and to plan how to take more control of our learning in the future without the language to describe our thinking and learning. For educational researchers it is impossible to describe aspects of the educational experience without developing concepts and terminology that can be identified with some reliability (or at least agreed regularity) across teaching and learning situations. With some clarity in these descriptions it may be possible to tackle important questions about how to improve education by attempting to measure

aspects of these essential components and therefore evaluate the impact of different approaches and techniques.

Thinking skills (or at least those skilled in thinking) are needed, not only in the worlds of work, education and training, but in the contexts of family, friendship and community and in the construction of personal and shared beliefs and values. There is good evidence that organisations are more successful the more they involve their members in the processes of problem-solving and decision-making. In the 'information age' qualities of independence and flexibility are highly valued and 'learning to learn' has become an important goal. A well-functioning democracy is not only one in which people feel that their views can be freely expressed and are adequately represented; but one where those views are informed by reliable information, critical appraisal of ideas, creative thinking and open debate.

A range of academic traditions has considered and examined thinking as an aspect of human experience. In particular, various philosophical, psychological and sociological perspectives provide insight into thinking and learning at both an individual and cultural level. Whereas psychology has always been interested in learning about the development of thinking and hence teaching and learning, the philosophical tradition has usually viewed thinking in terms of the theory of (adult) mind and the theory of knowledge (rather than learning or coming to know). Sociological tools offer valuable perspectives on what occurs in terms of the systems, their structures and functions in schooling and educational practices, and especially about the relation of the individual to the wider society with regard to customs, power and authority. Each of these traditions has influenced the frameworks, taxonomies and descriptions of thinking that we have collected and which we review in this handbook. Other traditions, of course, have relevance. Politics exert powerful influences on the educational practices of different cultures and eras and economic factors are often cited as having a significant impact on the policies that are implemented. Cognitive neuroscience and neurophysiology are beginning to have an impact on aspects of teaching and learning, despite the fact that descriptions of brain functioning are hard to translate into clear messages for classroom practice. In terms of the accounts of thinking described in this book, the various influences

have largely been mediated through psychological and philosophical traditions and their conceptualisations about thinking and learning to think.

In this first chapter we provide some background to these perspectives on thinking in education. A number of key terms and issues are outlined and discussed, since the evaluations of the frameworks and taxonomies which follow make some assumptions about the concepts and ideas that they rely upon. We give a brief overview of psychological, sociological and philosophical perspectives on thinking, and especially critical thinking. We then turn to the development of thinking skills approaches in education, including various programmes designed to develop particular aspects of thinking.

What is thinking?

Trying to understand how people think and learn is in some ways an impossible challenge, since we can only try to understand these things by using the very processes that we do not fully understand. In such circumstances choices are available. We can choose to focus on measurable aspects of human behaviour rather than on lived experience; or we can resort to metaphors which have personal or group appeal; or we can do what scientists have often done when entering a new and complex field – look for patterns and regularities between situations. All three approaches are evident in the theoretical frameworks and taxonomic approaches to thinking and learning that are described in this handbook and they all involve classification. Moreover, they all result in simplified accounts, since the human mind can only operate consciously with limited amounts of information.

Dewey's (1933) classic introduction to 'How We Think' offers an overview of some of the different senses in which the term *thinking* is used:

- thinking as a 'stream of consciousness' and the everyday 'uncontrolled coursing of ideas through our heads', including dreaming and daydreams (p. 3)
- thinking as imagination or mindfulness which is 'usually restricted to things not directly perceived' since we tend to say 'I saw a tree'