Questioning:
A Window on Productive Thinking

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About the Author

Lynn Newton is Professor of Education at Durham University, UK. Having completed her undergraduate degree in Biology, Physics and Education, she started her career as a teacher, working in primary schools in the North of England. She then moved into the Local Authority advisory service, supporting teachers in schools with the teaching of science and technology. She moved into University life in 1987, first at Newcastle University, where she taught science, environmental studies and design-technology on initial teacher training courses and higher degree programmes. In 1997, she joined Durham University to lead a new specialist primary science undergraduate degree programme. She now works across a range of undergraduate, postgraduate and higher degree programmes. Having served her 5 year term of office as Head of Department in the School of Education (2005-2010), she returned from research leave to take on the role of Divisional Director of Initial Teacher Training in the School of Education, a role she still holds today.

Lynn's research interests focus on areas of effective communication in teaching and learning, particularly the use of questions to promote causal understanding and thinking, and related strategies that enhance learning in science, which was the focus of her own PhD. Her recent work has been in the area of creative thinking and purposeful, productive thought (see for example, *Creativity for a New Curriculum: 5-11* (Routledge, 2012) or *From Teaching for Creative Thinking to Teaching for Productive Thought* (ICIE, 2013). She has published over a dozen books and over 100 research articles and papers in these areas, and spoken at a number of conferences.

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1. Introduction

For Claxton (2002, p. 24), 21st century education should be about building learning power. He describes a resourceful, learning-power mind as one which is ready and able to learn in different ways. He sees this as involving five elements. First, the educator must ask questions that burrow below the surface and enable the learner to play with situations. Second, learners need to seek coherence, relevance and meaning in what they are thinking about, and make connections. The third element involves using the mind's eye as a learning theatre, thereby bringing the imagination into play. The fourth involves thinking rigorously and methodically, and the fifth encourages making good use of resources. He sums these up as questioning, linking, imagining, reasoning, and, capitalising. Claxton suggests that effective 21st century learners need particular habits, traits and attitudes. These include:

> *... imagining, being, absorbed, researching, reflecting, stickability, noticing, questioning, resourcefulness, self-knowledge, playfulness, reasoning, collaborating, listening, [and] imitating.* (Claxton, 2002, p. 8)

I suggest that these habits of mind, at the heart of the kind of learning power encouraged by Claxton, are also the habits of mind that can help make thought productive and worthwhile – the kinds of thinking that are at a level beyond the basic, low-level thinking that underpins reproductive cognitive activity requiring recollection, recitation and single correct answers. Higher level thinking, through the combination and integration of information, enables the construction of meaningful and more comprehensive ideas that go beyond the information presented. The practice of productive thinking in academic contexts is often directed at reasoning, understanding, creative thinking, evaluative thinking and decision making.

Of course, if we are to develop such habits of mind, the first need is to know what thoughts are already in a learner's head. Questioning provides a ready means of accessing those thoughts and, significantly, of prompting them to go in the desired direction. For this, teachers need to be asking the right questions, that is, questions focussed on the kinds of thought expected in the classroom.

According to Gini-Newman and Case (2015), in their discussion about leading educational change for a 21st century world, the challenge for teachers is to create thinking classrooms. They argue that:

> *... a "thinking classroom" ought to orient every activity in school if we [teachers] are to realize the goals of 21st century reforms.... after all, thinking is fundamental to being human so, of course, it is central to virtually everything we do, especially in intellectual endeavours such as schooling.*
> (Gini-Newman and Case, 2015, p. 21)

For them, the thinking classroom has at its heart what they describe as quality thinking that is both rigorous and productive.

Gini-Newman and Case (2015) also note, however, that what they call rigorous thinking seldom permeates practices in many classrooms, partly because of the inappropriate use of frameworks for thinking such as Bloom's (1956) taxonomy of the cognitive domains. They argue that, in many classrooms, Bloom's taxonomy has been applied in ways which emphasise its three lower levels (knowledge, comprehension and application) while the higher level thinking processes (analysis, synthesis and evaluation) are perceived by many teachers as only being accessible to more able or gifted students. Pagliaro (2011) suggests that the reason for this is that teachers themselves can have difficulty formulating questions that are at a higher level than those that involve mainly recall. This is contrary to what, for Gini-Newman and Case (2015), learning in a thinking classroom is about, internalising a reasoned sense of the world.

> *Making reasoned sense requires building upon what is known about the world, but learners who simply accept the views of others won't have internalized and digested these ideas. Learners' primary responsibility is to reach their own conclusions based on careful and informed assessment of possibilities.* (Gini-Newman and Case, 2015, p. 37)

How can teachers realise Gini-Newman and Case's wish to create thinking classrooms in which rigorous thinking is taking place? How can we encourage learners to develop Claxton's resourceful learning-power minds so that they are ready and able to learn in different ways, regardless of what 21st century life throws at them? In this monograph, I will discuss Gini-Newman and Case's rigorous thinking in terms of productive thought, and explore how questioning as a frequently-used teaching strategy can be used to foster such thinking and, hence, help to develop Claxton's resourceful learners.

When students are learning in the classroom, Chin (2007) describes how the construction of meaning is mediated through language, and teacher-student interaction is a significant source of this mediation. Research also tells us that teacher-talk dominates this interaction. Newton, L. (1996) found over 60% of the talk was teacher-led, and Baumfield and Mroz (2002) found a slightly higher rate, of around 70%. I believe that such interaction in the form of questioning can provide effective support for understanding, meaning-making and higher-level thinking. However, confining attention to one part of a taxonomy, such as Bloom's (mentioned above), is not necessarily a helpful guide to the kinds of questions that make a difference to the quality of thinking. What matters more is that questions stimulate productive thought; that is, they produce the kinds of thinking that further the desired kinds of learning. What is needed is what I call *focused questioning*, questioning that facilitates the development of children's knowledge and understanding as the basis for productive thought and then scaffolds constructive and evaluative thinking and decision making.

When teachers ask questions the assumption is that they (the questions) do something useful and the more questions that are asked, the more good they do. Perhaps this is why research tells us that teachers ask a lot of questions during their lessons (e.g. Cotton, 1989; Newton, L., 1996; van Lier, 1998) and sometimes lessons can appear to be nothing but questions.

> *Teachers ask hundreds of questions every week, some requiring single word answers, others involving much more complex thought and understanding, many to do with the management of the class. Whole lessons can be built around one or two thought-provoking questions, involving the imagination, inviting children to recall vital information, understand a new concept, analyse, speculate and reason.* (Brown & Wragg, 1993, Introduction)

Mohr (1998) noted that teachers asked about one hundred questions per hour and Brualdi (1998) recorded 300-400 questions per teacher per day. Yet Walberg (1984) placed questioning only 17th for effectiveness in a list of 35 instructional strategies. Similarly, Hattie (2009), in his meta-analyses of research relating to achievement, found questioning to be one of the mid-range strategies for effectiveness, with a *d* value of 0.46[1]. Why is this so? The answer lies not with the quantity of questions but in their nature and their purpose.

One significant goal of productive thought is the construction of meaning and Gadamer (1993) suggests, *'Questioning opens up possibilities of meaning'* (p. 375). Are teachers asking questions that 'open up' such possibilities? Research indicates that they use questions for a variety of purposes, from assessment and monitoring of the learning to organising and managing the learners. However in terms of supporting rich learning experiences that lead to productive thinking, teachers' questions generally lack variety (Newton, L., 1996; Brualdi, 1998; Greenleaf, 2006). The changing needs of learning situations can be ignored. Hattie (2009) sums up the problem as relating to:

> *... the conceptions of teaching and learning held by many teachers – that is, their role is to impart knowledge and information about a subject, and student learning is the acquisition of this information through processes of repetition, memorization, and recall.* (Hattie, 2009, p. 182)

He advocates higher-order questioning to enhance understanding and higher level thinking.

Questioning as strategy has the potential to support students of all ages as they relate facts, construct meanings, satisfy their curiosity, imagine alternative worlds, make decisions, solve problems and build and change their mental models of the world in which they live. However, it is not so much the number of questions asked by the teacher that matters but

[1] Hattie (2009, p.7): '*... an effect size provides a common expression of the magnitude of study outcomes for many types of outcome variables, such as school achievement. An effect size of d = 1.0 indicates an increase of one standard deviation on the outcome ... [1 s.d.] increase is typically associated with advancing children's achievement by two to three years ... [or] improving the rate of learning by 50%.'*

what they do for the learner. A few well-shaped questions that focus on the needs of particular thinking at crucial times are likely to be of more benefit than a hundred questions, scattered like confetti and demanding only the quick recall of facts. Well-shaped questions cannot, however, always be conjured up from thin air but are likely to benefit from forethought and planning.

Following a brief review of the history, nature and role of teachers' questions in the classroom, I will discuss what is meant by productive thought. I will then bring the two together and present some ideas about questioning for the particular purpose of encouraging understanding and higher-level thinking – *focused questioning*. It is argued here, questions should be *shaped* and *focused* to reflect the immediate needs of the situation and support mental processes on the way to better thinking.

2. Questioning

Questioning is an interrogative act. Unless the question is rhetorical, the questioner generally does not know the answer and desires to do so. In the classroom, learners' questions are often of this kind, but not those of teachers. Teachers often already have acceptable answers in mind, or, at least, a mental concept or model of what would constitute an acceptable, plausible or appropriate response.

Research into questioning is not, and has never been, the sole concern of educators. Dillon (1982) surveyed the literature on questioning in twelve different fields of thought (such as anthropology, linguistics, psychology, psychotherapy and semantics). Each had a different emphasis and a different approach. He found a diverse range of theories and practices, each standing in relative isolation from the rest. He suggested, however, that they had much to contribute to one another's concerns and a multidisciplinary view should be adopted. Yet despite his meta-analysis, Dillon was unable to construct a reliable working definition of questioning, as he found no single set of characteristics common to all types and functions of questions. He concluded:

> *Of all the literatures on questioning, that in education is the oldest and largest, and is probably the most encompassing of the many facets of questioning.*
> (Dillon, 1982, p. 152)

The wealth of literature on questioning in education has been regularly reviewed over the last fifty years (see, for example, Sanders, 1966; Gall, 1970; Dillon, 1982; 1988; Morgan & Saxton, 1991; Newton, 1996; Mercer, 2005; Chin, 2007). All sources agree that questioning as a strategy is extensively used in all aspects of teaching and learning: in textbooks and work cards, in assessment tasks and, most commonly, in various aspects of classroom discourse, including to do with class management. Many studies have generated a variety of systems or taxonomies for sorting and classifying questions into categories. Much of this work has been North American in origin and, in the educational context, has tended to focus on older school pupils and college students although in more recent years research has been carried out in other parts of the world and with younger (primary or elementary school age) children.

2.1 Questioning in educational contexts in the past

Pope (2013) describes questioning as a teacher's bread and butter, the basic staple of teaching life. Snapshots from history show us that the use of teachers' questions in this way in educational contexts spans not just centuries but millennia (McNamara, 1981). For Socrates, '*A question is a midwife which brings forth ideas from the mind.'* (quoted by Austin, 1949, p. 194) . But asking lots of questions does not necessarily mean that those questions make the learners think in productive ways.

Midwives of this kind - asking questions in one form or another - probably existed long before Socrates but Socratic questioning is one of the oft-cited illustrations of its use in educational contexts (Dillon, 1990). Socrates forced people to think, and think deeply, with his incessant press for answers intended to draw out understanding and to justify assertions (and he was not always popular for it). In other words, he questioned purposefully, in order to reveal and prompt productive thinking. Socrates is said to have treated participants in this dialogue as equal partners, so that each can assume the roles of interrogator and respondent. When his students expressed an opinion, he used closed questions to invite them to exhibit their ideas, exposing the extent of their knowledge and understanding. Then he challenged their views with new data or ideas or by pointing to logical inconsistencies. Socrates' use of questions was more as a tactic to manage answers – it was a means of stimulating student-centred enquiry. Paul and Elder (2007) provide an account of Socratic questioning to support their notions of critical thinking concepts and tools and argue that thinking processes are driven not by giving answers but by asking questions. They suggest:

> *Questions define tasks, express problems, and delineate issues. Answers on the other hand often signal a full stop in thought. Only when an answer generates a further question does thought continue its life as such.*
>
> (Paul and Elder, 2007, p. 62)

Often, it is the teacher's role to generate the further questions.

Socratic questioning, as it has become known, has proved to be a long-lasting strategy, and is still seen in many university oral examinations for higher degrees as the familiar *viva voce,* the means by which the breadth, depth and quality of a candidate's thinking about his or her thesis is tested.

In the Middle Ages in England, a monk, Aelfric of Eynsham, wrote study aids in which pupils were asked questions about a range of characters like the ploughman, the hunter and the fisherman (Evans, 1978). In the sixteenth century, the scholar Francis Bacon, stressed the educational value of questions, arguing:

> *He that questioneth much shall learn much, and content much, but especially if he apply his questions to the skill of the person whom he asketh, for he shall give them occasion to please themselves in speaking and himself shall continually gather knowledge...* (quoted by Morgan & Saxton, 1991, p.ii)

Although Bacon focused on the learner, rather than the teacher, this highlights a process seen as worthwhile at that time. Little changed and in the eighteenth century, an extract from the diary of a country schoolmaster in the UK in 1784 tells us that:

> *[Dec]16 Thursday Snow this afternoon. Evening was reading the Roman History by question and answer. Have read about half of it, and recommend on it, to be read by school boys...* (Coates, 1784, p.37)

This ‘question-and-answer’ method reflects the use of the ‘catechism’ approach which was dominant in schools in England, and probably elsewhere in Europe, in the late eighteenth and nineteenth centuries. The approach, which mirrored the rote learning of the Catechism in churches, involved a pattern of teacher-question and pupil-recitation of factual information acquired by rote learning in response. Gosden (1960) quotes from C. Irving's book, *A Catechism of Botany* (1821), which exemplifies the approach. The teacher (T) is discussing plants and the pupil (P) is responding with what he has learned by rote.

> *T. What plants are of the second class?*
> *P. To the class Diandria belong all the plants which have two stamens in each flower.*
> *T. What native plants are there of this class?*
> *P. The privet, butterwort, meadow-sage, brook-lime speedwell, and others are common in Britain; and the last of these may be chosen to illustrate the class.*
>
> (Gosden, 1960, p.118)

During the nineteenth century, Sir Joshua Fitch, in his book on *The Art of Teaching*, described how teachers cultivated memory at the expense of ‘higher intellectual powers’, and pointed to questioning as a strategy teachers could use to encourage thinking. Despite such prescience, questioning for rote learning of facts and ideas was still prevalent in the object lessons of the 19th and early 20th centuries:

> *There were ‘object’ lessons now and then - without any objects but with white chalk drawings on the blackboard - an oil-lamp, or a vulture, or a diamond might be the subject. Once there was a lesson on a strange animal called a quad - ru - ped -- cloven footed, a chewer of the cud; her house was called a byre (but in Tysoe it was not); her skin was made into shoes and from her udder came milk. It burst upon Joseph that this was one of the creatures he would milk after school, part of Henry Beasley's herd. He would milk three or four cows...*
>
> (quoted in Ashby, 1961, p. 18)

Nor is this emphasis on this kind of questioning confined to schools. It was evident at all levels of education. For example, Brewer (1894) described the focus on questioning in the early examination procedures at the University of Cambridge:

> *... it was customary, at the beginning of the January term, to hold `Acts', and the candidates for the Bachelor's degree were called `Questionists'. They were examined by a moderator, and afterwards the fathers of other colleges "questioned" them for three hours... It was held altogether in Latin, and the words of dismissal uttered by the Regius Professor indicated what class you would be placed in...* (Brewer's Dictionary, 1894, pp. 1027-8)

2.2 Questioning in classrooms today

In twentieth century classrooms, according to Myhill *et al* (2006), teachers' questioning remains the most common strategy for generating pupil responses in learning situations. The use of what has become known as triadic dialogue (Lemke, 1990) has been well reported. Typically, triadic dialogue involves three steps:

- *I = initiation* (by the teacher, usually a question);
- *R = response* (by the student, usually the "correct" answer, as when the student gives the answer that he or she thinks the teacher expects); and,
- *F or E = feedback* or *evaluation* (by the teacher, indicating acceptance or otherwise of that answer).

This is commonly referred to as "I-R-F" (Sinclair and Coulthard, 1975) or "I-R-E" (Mehan, 1979). Tharp and Gallimore (1988) labelled this kind of interaction as a "recitation script" and research by Smith *et al* (2004) in developed countries and Abd-Kadir and Hardman (2007) in developing countries indicated recitation scripts were the most frequently used modes of talk in classrooms.

Chin (2007) describes this three step pattern as typical of traditional teaching, generating responses that are minimalist and restrict thinking. The problem with such an approach is that it can become nothing more than reproductive or rote learning. It can be very easy to slip into the habit of inculcating facts and neglect understanding and higher level thinking. Facts are important, without them there is nothing to think about. Understanding, for instance, is a powerful way of knowing and is important. For understanding to happen, however, the learners have to be encouraged to construct meaning for themselves, not simply reproduce it. To that end, Gallagher and Ascher (1963) produced a questioning taxonomy to help teachers do that (see Figure 1). They identified four question levels in increasing order of cognitive challenge or intellectual demand.

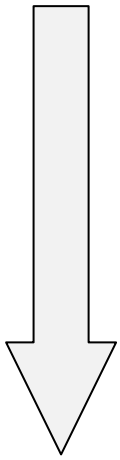
Lower Level  Higher Level	Cognitive memory questions	*Rote memory; recall of prior learning; recognition of information*
	Convergent thinking questions	*Integrating information; analysis of ideas; synthesising data*
	Divergent thinking questions	*Generating new ideas; putting forward new ideas / views; recognising more than one possibility*
	Evaluative thinking questions	*Quality assuring thinking; making judgements; decision making*

Figure 1: Gallagher and Ascher's 1963 questioning taxonomy

When asked a question, most people (whether adults or children) will attempt to construct some kind of response. The majority will base this response on conventional expectations that their prior learning and experiences have prepared them for (Michalko, 2001). When the response simply stems from a memory trawl, it reflects *reproductive thought*. Prior learning and previous experiences enable us to reproduce answers that have been memorised or rote learned, and use strategies and approaches that have worked successfully in the past. Such answers may be sufficient if all that is required is, *"What is seven multiplied by eight?"* or *"What is your grandmother's telephone number?"* Strategies that assist in this processing are useful, such as the rapid learning of multiplication tables or using a mnemonic to remember the order of the colours of a rainbow. However, this encourages a degree of rigidity in thinking and explains why, when confronted by a new context, respondents fail because drawing only upon past experience does not help and may even hinder their construction of an answer.

Greenleaf (2006) points to numerous studies of teachers questioning that indicate the abundance of fact-oriented questions, and a scarcity (c.1%) of higher-order, conceptual questions. In the area of science, this was found to be true by the author over 20 years ago (Newton, 1996) and is still seen in science classrooms today (Hind, 2016). The long history of questioning as a strategy is largely one of encouraging reproductive thinking after rote learning, often for reproducing what was previously learned for a test or examination. Evidence of the use of questioning for more productive thinking has had a much shorter history. For example, Paul and Elder (2007) argue that:

> *If we want productive and effective thinking to occur in the minds of our students, we must stimulate student thinking with questions that lead them to further questions. We must overcome what previous schooling has done to their thinking.* (Paul and Elder, 2007, p. 63)

This calls for some reflection on 'productive and effective thinking'.

3. Productive Thought

The notion of productive thought seems to have first been used over half a century ago by the Gestalt psychologist Max Wertheimer (nd). He was interested in what occurred when thinking was productive, when the individual's thinking goes from a state of confusion about an issue to a new state in which everything about the issue becomes clear, makes sense and fits together. Romiszowski (1981) also applied the term productive thinking to Bloom's (1956) higher level thinking – the analysis, synthesis and evaluation processes – and the term can also be applied to various revisions of these (such as Anderson & Krathwohl's 2001 version), and related thinking processes that result in deeper understandings, defensible judgements, or valued products.

Productive thought is what can successfully generate ideas, develop plans, guide decision making and problem solving, and lead to actions. It is a valuable asset for people setting out to engage with and survive in the world and is the kind of thinking that has the potential to generate actions that can change minds and lives. According to Michalko (2001), the US physicist and Nobel Laureate, Richard Feynman, proposed that schools should teach for *productive* rather than *reproductive* thought. Feynman argued that this would encourage learners to be flexible and think of new and alternative ways of thinking and working.

In a situation where all the question demands is a reproductive response, many pupils will produce the conventional answer they anticipate the teacher wants. Some may not produce an answer at all. A few might produce something that, at first glance, makes no sense or does not seem to fit expectations. They have looked at the question in a different way, played with ideas and been productive by generating alternative solutions.

Productive thought (as opposed to reproductive thought) covers a variety of forms of cognitive activity: deduction; understanding and causal reasoning; creative thinking and problem solving; evaluative or critical thinking; and decision making and wise thinking (Newton, L., 2013). It entails constructing understandings, imagining situations, planning what to do, solving problems, generating new perspectives, designing and making products and articulating and quality assuring such constructions (Moseley *et al*, 2005, pp.313-14). Such thinking may also be influenced by moods and emotions, sometimes for the better and sometimes for the worse (Newton, D., 2014). This is represented diagrammatically in Figure 2.

It is important to note that these different types of cognitive activity, or different kinds of thinking, overlap. Gini-Newman and Case (2015) recommend an integrated approach to fostering thinking skills, in which the relationships between creative thinking, critical thinking and other forms of thinking can be characterised as distinct but intertwined forms of thinking. What is needed is to embed them in a broader framework.

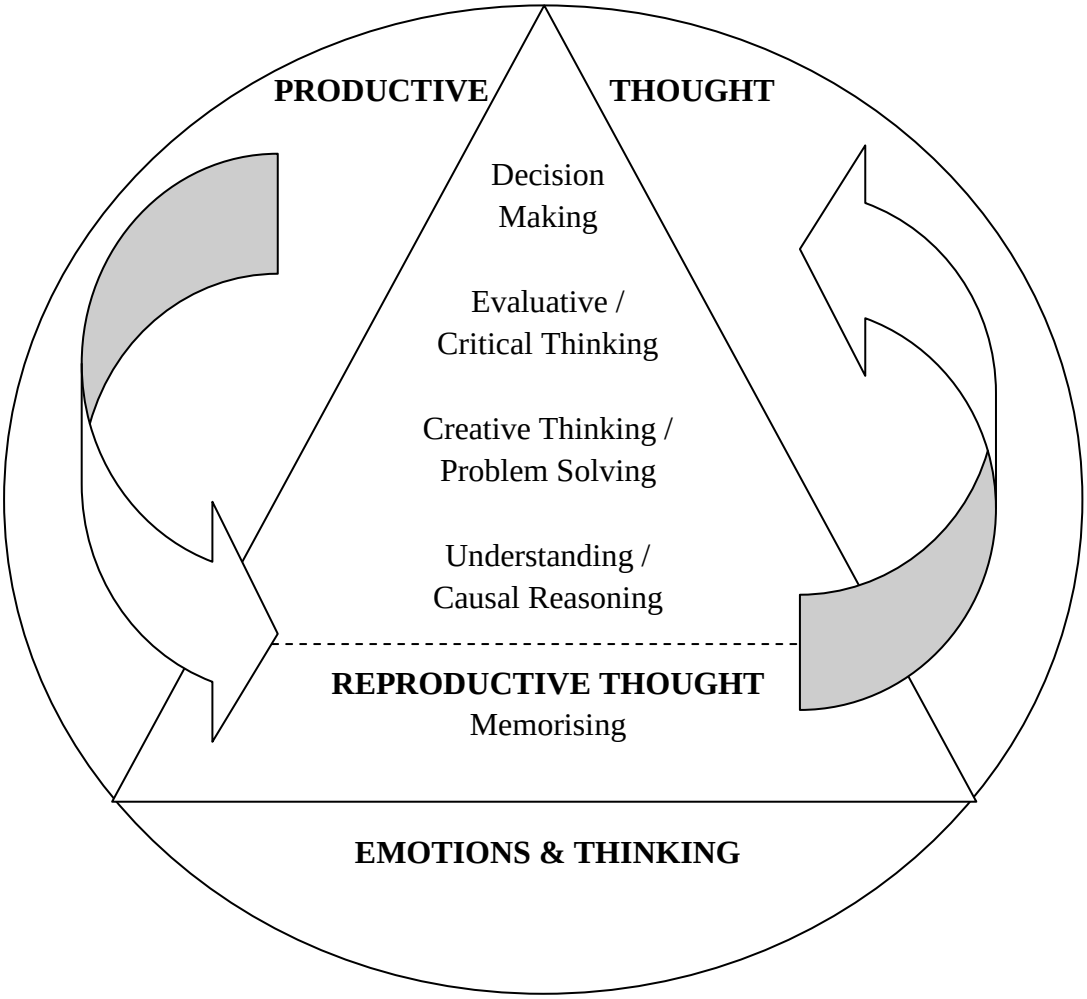


Figure 2: A Model for productive thought

The generation of ideas and the consequences for subsequent actions are fundamental to productive thought. As such, understanding and causal reasoning, creative thinking and problem solving, evaluative and critical thinking, and decision making and wise thinking are interwoven at the heart of productive thinking like a strand of DNA (Newton, L., 2013). Further, this productive thought can be developed by practice through opportunities provided by the teacher. In this way, habits of mind are fostered – the habits, traits and attitudes pointed to by Claxton (2002).

Perhaps a brief overview of the elements to show how each interacts might be useful (for a full account, see Newton, D., 2012; Newton, L. 2013; Newton, D., 2014). It is important to emphasise that, although these levels will be described separately, they are, in fact, interdependent. They are also within the grasp of learners of all ages working in various curricular contexts.

3.1 Reproductive Thought - Memorising

We cannot think productively in a vacuum. We need something to work on, often provided by memory. Put simply, when we memorise something it often means we learn it 'off by

heart'. It is learning by rote and is the essence of reproductive thought, where the emphasis is on knowing facts – information and its recall to generate correct answers. Knowing facts can be very useful and enable ready responses. Names and dates, symbols and signs, mnemonics - these may all be useful, but it is the relationships between the facts that can matter more and how these are used to make meaning. There needs to be a sound knowledge base, developed through rich and relevant learning experiences, regardless of the subject domain, so teachers need to know how they can support the acquisition of factual information. If we want children to think productively, then we need to move beyond knowing the facts.

Meyer (2000), in his work with university students, noted that there was a conceptual distinction in how students use memorising strategies in their learning. These included memorising as process of rehearsal (more usually equated with rote learning), and memorising strategies before, after or with understanding to support deeper learning and higher level thinking. What is relevant here is the important pointer to a bridge between reproductive thinking and the beginnings of productive thought.

3.2 Productive Thought - Understanding and Causal Reasoning

Understanding and causal reasoning underpin the levels in the pyramid identified as productive thought. It is much more than knowing facts and information well enough to help the student pass a test; it enables a kind of cognitive autonomy and as such, it is a powerful basis for higher levels of thinking activity (Newton, D., 2012, p. 8). While a good memory is useful, this doesn't necessarily indicate understanding. For example, in a science lesson, the question, *"Which substance has the chemical symbol H_2O?"* will probably generate the immediate answer, *"Water."* But the answer does not tell us what the respondent understands by H_2O. Does he or she understand elements and compounds? While facts are components of understanding, they are not, in themselves sufficient for understanding.

Understandings are about constructing or creating connections between existing and new ideas. They require personal constructive activity that involves the making of mental connections. At a simple level, making connections within knowledge and to prior knowledge builds meaning and understanding. However, the learner has to do it for him or herself and it requires mental effort. Causal understanding is a particular kind of mental connection which enables the answering of *Why?* and *What if ...?* questions, and they are often the product of causal reasoning, the notion that a cause leads to a particular effect. According to Keil (2006), understanding depends upon the ability to comprehend cause and effect. Causal reasoning enables us to construct meaningful relationships between ideas (for example, *The boys were playing with the ball; the greenhouse window is broken; the ball is in the greenhouse; so one of the boys must have kicked the ball and it broke the window.*) .

Greenleaf (2006) recommends that teachers think about how they encourage learners to build on what is already known and understood to go beyond it in their thinking, pointing to what research tells us about how teachers set up experiences to do this. He describes research on how much is actually retained by learners after one month, according to the learning experiences. He found that after one month, only 14% of learning through auditory

experiences and 22% through visual experiences is retained. However, experiences that required the application of new knowledge, or the teaching of it to others, were much more successful, with 83% and 92% retained after one month, respectively.

Bowkett (2007) argues that understanding prepares the way for creative thinking through experience, familiarity, competence, confidence, and independence of judgement. He adds that:

> *Understanding an area of knowledge* [such as history or science or music] *opens up the opportunity to play creatively in that arena.*
>
> (Bowkett, 2007, p. 12)

3.3 Productive Thought - Creative Thinking and Problem Solving

Understandings, and the explanations derived from them, are mental constructions and the constructive process is, in essence, personally creative. Because it is a personal construction, what one individual constructs will be different from that of another, because the knowledge and understandings brought to the cognitive enterprise differs. Piaget (cited by Claxton and Lewis, 2015) proposed an education system that focuses on the learners' creative thinking in classrooms.

> *The principal goal of education in schools should be creating men and women who are capable of doing new things, not simply repeating what other generations have done; men and women who are creative, inventive and discoverers, who can be critical and verify, and not accept everything they are offered.* (Jean Piaget, cited by Claxton & Lucas, 2015, p.171)

Creative thinking does not necessarily differ from the kinds of thinking we use in daily life to make sense of the world, solve problems, make plans and negotiate life (Amabile, 1983; Boden, 2004). While the concept of creativity itself may be difficult to define, the creative thinking processes underpinning the multitude of definitions that exist have common features (like using the imagination, or cognitive risk taking), resulting in a generally agreed description of creative thinking as a process that produces something that is novel, purposeful, and has some kind of value, at least to the individual who created it. Despite the popular belief that creativity is associated only with the arts, it is found in all academic disciplines (Claxton, 2006; Newton, 2013). Moreover, we are all, at times, whether young or old, gifted or not, creative, in spite of what we ourselves might think.

Closely associated with creativity is problem solving. Situations in which creative opportunities arise are not always the same and therefore the identification of needs, the recognition of problems, the generation and testing of possible solutions, their evaluation to determine the most appropriate solution, and the refinement of ideas are all productive processes. The mental processing that leads to understanding and enables creation and re-creation, also leads to speculation and evaluation and therefore uses higher level thinking processes, as described in Anderson and Krathwohl's version of Bloom's taxonomy (2001). That is:

1) Knowing (remembering / recalling);
2) Comprehending (basic level understanding);
3) Applying (using skills, knowledge and understandings in different ways and contexts);
4) Analysing (explaining different ideas and showing their relationships);
5) Evaluating (using ideas to make judgements); and,
6) Creating (drawing on existing and new ideas to make something new).

They place creativity at the pinnacle of their taxonomy.

3.4 Productive Thought - Evaluative and Critical Thinking

The constraints placed upon what counts as understanding and creative thinking in different subject areas vary (Newton, D., 2012). While it is the imagination which produces the creative ideas, it is evaluative and critical thought that provides and applies the constraints in what Newton describes as the quality control in the relationship. Critical thinking is thinking that is reasonable and reflective and which focuses on decisions about what to do or believe (Ennis, 1987). The key component of critical thinking involves making a judgement – in the light of all the evidence and its quality control and knowing relevant criteria, what is it reasonable or even sensible to do or believe?

There are numerous definitions of critical thinking (see Moseley *et* al, 2005) but for some, being critical tends to have negative connotations. For example, students, even graduates in universities, seem to confuse being critical (about an idea, a piece of information, or a research report, for example) with being negative about it. For this reason, in educational contexts, it can be useful to think about evaluative thinking – thinking that focuses on those skills of evaluation that can lead to a justified judgement. With evaluative thinking the cognitive processing is often motivated by a belief in the value and importance of evidence and a desire to satisfy curiosity or solve a problem. Underpinning evaluative thinking are skills to do with the identification and testing of assumptions, a search for deeper meaning and understanding, and the taking of alternative perspectives. Often these skills can be activated by thoughtful question asking or answering. An alternative term used by Bertrand Russell (in Hare, 2001) was the notion of *constructive doubt.* This redirects thought away from an exclusive concern with negative criticism towards a constructive, balanced evaluation.

Ennis (1987) provides a description of critical thinking skills, many of which, according to Sternberg (2001), are also required in wise thinking. He suggests that developing wisdom is important because it enables judgments that can improve the quality of life, advocating that teachers should encourage students to think about the common good, try to see things from the viewpoint of others, balance their own interests with the interests of others, think long-term, incorporate ethical values into decisions making, and recognise the variability of what is perceived to be true.

3.5 Productive Thought - Decision Making and Wise Thinking

Evaluative thinking is often purposeful, with the goal of reaching conclusions and making a decision. Here, the thought processes are concerned with making a 'good' choice from available options. When the choice is between whether to eat a cheese or a tomato sandwich at lunch time, it may not matter which choice is made, even if, having chosen cheese you wish you had gone for the alternative. When it comes to which subjects to study in preparation for a career, it really does matter. Choosing only those a student enjoys or finds easy may not necessarily be a 'good' decision because they may not be the ones that will gain access to the university degree or the career he or she wants to pursue. So there has to be wisdom built into the decision-making process. Charles Darwin, when deciding whether or not to marry, drew up a list of the advantages and disadvantages, then, after deliberation, made his decision and, presumably, he thought it was a wise one.

Sternberg (2010) proposes his unified model for cognitive processing (WICS – Wisdom, Intelligence, and Creativity, Synthesized), in effect describing wisdom as a multi-dimensional construct that draws on a wide range of thinking skills. While it is unlikely that the thinking, experience and development of young children will enable them to engage in wise thinking in its entirety, they could and should be developing ways of thinking which could eventually contribute to their wise thinking in adult life.

As a closing thought, in his paper on the WICS model, Sternberg (2010) suggests:

> *... citizens of the world need creativity to form a vision of where they want to go and to cope with change in the environment, analytical intelligence to ascertain whether their creative ideas are good ones, practical intelligence to implement their ideas and to persuade others of the value of those ideas, and wisdom in order to ensure that the ideas will help achieve some ethically-based common good ...* (Sternberg, 2020, p.603)

Surely, that is what we all want to achieve for all of our students.

3.6 Productive Thought in Schools and Classrooms

The value placed on and the extent to which productive thought is fostered in schools can vary with culture. Within a Western culture it is highly valued, with a belief in fostering it in schools. This view is reflected in the UNESCO (2006) report which encourages worldwide creativity and critical thinking (defined broadly to encompass many aspects of productive thought). Globalisation seems likely to spread it further although other views should be expected and respected. This aligns well with what Gini-Newman and Case (2015) call *thinking classrooms*. I argue that all students can benefit from instruction within a broader framework of productive thinking. It can help them to develop their abilities to notice, question and explain, think creatively and critically, weigh evidence and make decisions, meet needs and solve problems, be logical and develop reasoning, and judge wisely. Beyer (2001) argues that:

> *Unless the learning environments of our classrooms nurture and support student thinking, especially higher-order thinking, our students are unlikely to be very receptive to continued efforts on our parts to help them improve their thinking.* (p. 418; cited in Gini-Newman and Case, 2015, p.65)

However, while lip service is paid to fostering productive thought, in practice, it is often the first to suffer in examination-led curricula which reward minds full of facts. Nevertheless, schools sometimes adopt specific programmes for nurturing thinking and use them once a week in specific lessons. Such programmes can be more useful when they are applied within a structured approach across all subjects underpinned by a theoretical framework. For example, methods such as de Bono's *Six Thinking Hats* (1985) align well with the productive thinking across the curriculum.

- White hat Reproductive thinking / facts and information
- Red hat Thinking, feelings and emotions
- Black hat Decision Making and wise thinking
- Yellow hat Evaluative thinking
- Green hat Creative thinking
- Blue hat Thinking about thinking

For example, de Bono's green hat signals that creative thinking is required. This can be extended productively when the learner is wearing the green hat, by asking questions that prompt creative thinking and problem solving can guide and focus the direction of thought.

Addressing pedagogic needs in this way, with a framework for productive thought as represented in Figure 2 (earlier), has a number of advantages. First, it moves away from potentially thinking about thinking in isolation, detached from specific areas of the curriculum. It also makes it clearer how the products and processes inherent in an area of the curriculum can underpin deep learning and productive thinking within that subject. Finally, it provides a means by which subject boundaries become less important and the transferability if skills, knowledge and understandings can be more fully practised. A unifying model merges together different kinds of thinking. By doing so it is possible to make the relevance of experiences explicit.

3.7 The Elephant in the Classroom – Moods and Emotions

Newton, D. (2014) describes how the role of emotions in various kinds of productive thought has been ignored. More recently, researchers have begun to turn their attention to the interaction of emotions and cognition. At the same time, the concept of emotional intelligence has gained some currency, especially in the USA, although it means different things to different people. The effects of the interaction between emotions and what we commonly call rational thought, however, are potentially far-reaching and often hidden. Teachers are unlikely to be aware of them or know how to respond to them, especially in the context of supporting productive thought. Newton argues that:

> *Teachers are expected to foster productive thought, yet the neglect of emotion in the classroom in favour of the intellect, means teaching and learning is not as effective as it might be.* (Newton, 2014, Introduction)

In their discussion about creating a culture for thinking, Walsh and Sattes (2011, p. 147) describe how beliefs about how learning occur, and about how one's own cognitive abilities affect a learners readiness and willingness to develop a particular habit of mind. Dweck (2006) had already made a distinction between those who have fixed mind-sets and those with growth mind-sets. The former believe abilities and traits (such as intelligence and personality) are fixed and cannot be changed; the latter believe change is possible through hard work and appropriate experience. The impact of emotions on learning – both those of learners and those of teachers – is significant in this scenario.

4. Focused Questioning for Productive Thought

In recent years there has been increasing interest in dialogic teaching, an approach designed to use pupil talk to stimulate and extend their thinking. For example, Rojas-Drummond and Mercer (2003) noted teachers using questions to encourage extended talk, guide learning and model use of language. In his paper, Alexander (2008) discusses dilemmas faced by teachers in the classroom when trying to encourage dialogic talk and give children time to think. One of the dilemmas he discusses relates to questioning:

> *Dialogic teaching requires the extension and appropriate use of a broad repertoire of different kinds of teaching talk, yet questions from the teacher remain far and away the most dominant form of teacher talk. Why is this? And what, in the promotion of children's understanding is the right balance of questioning and exposition? When should we question and when should we tell, inform or explain?* (Alexander, 2008, p. 49)

I would like to re-phrase Alexander's question and ask: *Why should we question? What is the purpose?* For me, this is to do with promoting productive thinking and developing thinking classrooms. An important additional point made by Alexander is that, while carefully conceived questions are important, equally careful attention needs to be given by teachers to pupils' answers and how those answers are used for further learning.

Research shows that many teachers, particularly in primary or elementary schools, are not secure in their subject knowledge for all of the domains they have to teach (see, for example, Newton & Newton, 2000; Murphy *et al*, 2007). There is also evidence that this lack of teacher confidence can impact directly on teachers' classroom practices, forcing them to rely heavily on curriculum texts for their subject knowledge (Papageorgiou and Sakka, 2000). Similarly, Harlen and Holroyd (1997) found that teachers use teaching methods and approaches they feel 'safe' with and they discourage questions they cannot answer or which call for an explanation. In the context of elementary science education Newton, L. (1996) found that teachers avoid *'Why?'* questions in lessons in favour of questions that recall of factual information, particularly '*What?'* and, '*How?'* questions. *'Why?'* questions tend to be more open ended, calling for constructed, extended responses. *'What?'* and *'How?'* questions, on the other hand, are often 'closed' and are intended to generate recall. This point is also made by Hardman (2008), who noted:

> *... research has focussed on the promotion of 'higher-order' questioning techniques to promote reflection, self-examination and enquiry through the use of 'open' questions which invite students to speculate, hypothesise, reason, evaluate and to consider a range of possible answers. However, the use of questions in the classroom as a strategy for guiding the co-constructing of knowledge was strongly challenged by empirical evidence which showed the overwhelming reliance of teachers on 'closed' factual*

> *questions in which students provide the 'right' answer as defined by the teacher.* (Hardman, 2008, p.135)

As a consequence, a lot of the learning in classrooms is reproductive rather than productive. Teachers fall back on shallow or surface learning, the rote learning of facts, memorisation of information, and the reproduction of those rote learned facts in tests and examinations. This may even be supported by the objectives underpinning many prescribed curricula which tend to emphasise information acquisition (rote learning) and comprehension (a pre-requisite of a fuller understanding). For example, in a curriculum programme for science, children might be expected to learn that light travels in straight lines. In an end-of-unit test they are asked by a teacher, "*How does light travel?*" They write down, "*In straight lines*." and this is then marked as correct which, of course, it is. But what does it tell us about what this means to the learner? Has the teacher talked with them about their ideas? Has the class explored those ideas and tested them (for example, looked down a length of hosepipe to see if they can see the light at the other end)? Have they considered its relevance and application to life (for example, in mirrors, periscopes and cameras)? Have they tried to apply their ideas in new contexts (for example, to design and make their own device to see behind them without turning around)? It is from this shift from memorised information to thinking about these kinds of experiences that understanding grows and creative and evaluative thinking can be developed.

Few teachers, regardless of age or subject, are likely to argue that productive thought is unimportant. Nevertheless, it is often neglected for the quick fix that promotes rote learning, memorising facts for recall, and meeting external pressures of tests and examinations. Given the extent to which teachers are being urged to teach for understanding and support creative and critical thinking and problem solving, questions focused on productive thinking could be a useful tool. During the flow of a lesson, the kind of cognitive engagement needed by a group of learners will vary. Initially, it might be recall of what has already been learned, but it is unlikely to remain so. For instance, some development of understanding, perhaps creative thought and evaluation could follow. In other words, a given lesson is likely to provide opportunities for a *variety* of higher order questions that range over a *variety* of kinds of thinking. It is rarely the case that only one kind of thought is to be exercised in any one lesson. A teacher, then, needs to plan for this diversity.

Fusco (2012) suggests that teachers need to encourage students to do something mentally to make the ideas and information come together and connect. She provides an example of a chart of different types of interrogation phrases matched to thinking skills required for use by teachers to help them do this. This is summarised in Figure 3.

Questions or question starters	Thinking Skill Required
Identify the	Noticing and clarifying the details or attributes
Describe or explain	Giving details and telling attributes
How are they alike or different?	Creating groups with attributes
Retell the story giving ...	Sequencing the events
What is the main idea?	Combining / transforming data
What is your conclusion?	Grouping ideas and transforming them
How would you compare ...?	Creating a relationship
Predict the outcome ...	Sequencing and transforming data given the known
Match these ...	Comparing attributes of items or groups
Judge the success	Creating and evaluating based on criteria

Figure 3: Fusco's question types *(adapted from: Fusco, 2012, p. 103)*

4.1 Questioning for Productive Thought

Much of the early research on questioning seems of little practical help to teachers. It did, however show that teachers differ enormously in how they use questions but the variety of questions tends to be small so that most are to do with managing the class or asking for the recall of facts and rehearsing answers. For instance, Brown & Wragg (1993) found that the questions of primary (elementary) school teachers amounted to some 10% of a day's interaction. They analysed over 1,000 questions asked by these teachers. Most (92%) of the questions were to do with management and class control. Of those to do with the lesson content, most were of the closed or recall of factual information type. There were far fewer (8%) open or more demanding questions that went beyond the recall of facts or asked for extended answers. They suggested that:

> *... teachers do not necessarily prepare such questions, but somehow expect them to arise spontaneously. It may be that if we want to ask questions to get children to think, then we've got to think ourselves about the questions we are going to ask them.* (Brown & Wragg, 1993, p. 14)

In another study by Newton, L. (1996), fifty elementary teachers, when asked about the questions they use, all claimed to use a full range of questions in their lessons, including those that encourage higher level thinking. When 26 of them were observed teaching they did indeed use a lot of questions. However, the majority (nearly half) were questions requiring recall of information (*What ...? Where ...?When ...?*) or of procedures (*How...? Who...? Which...?).* The teachers rarely went beyond recall, seldom pushing the children to explain ideas (*Why...?*), predict (*What if ...?*) or apply their existing ideas in new contexts (*Could you ...? Does ...?*). Teacher-surrogates (work-cards, schemes and books designed for students to use) were also examined for the types of questions asked, with very similar results.

The point is that teachers, and the authors of books and teaching schemes, may ask a lot of questions but not always about the lesson in hand or necessarily to the best effect. They rarely ask questions which promote understanding and higher level thinking, such as analysis and synthesis or creative and critical thinking. Teachers are not, of course, equally confident across all subjects they may be asked to teach, especially in the elementary classroom. Where underlying subject knowledge is not very secure, the teacher may find it easier to focus on facts. They may even think that it is facts that count as understanding in a given subject. Yet Newton & Newton (2000) found that in elementary schools while the majority of teachers are without a higher school qualification or experience in science, there are some teachers who *do* ask for more than facts and there are also those with science degrees who seem to ignore everything other than facts. It is quite likely that the situation is similar for other subjects and at other stages of education.

At the same time, teachers may see their role as being simply to transmit what is known about a topic and not to promote active mental participation and the construction of understanding (Rodriquez and Kies, 1998). Elder and Paul (1998) have described this as burying thinking under tonnes of information. By using triadic dialogue approaches (the three-part *Initiation, Response, Evaluation* or *Feedback* structure to a teacher questioning, mentioned earlier) and asking closed questions (those that lead to a particular, expected, short answer), the teacher diverts the thinking from wider problem solving to a search for some 'right' or 'correct' answers which the teacher has pre-determined. In some instances, the cognitive work has been done by the teacher, not by the learners. Related to the cognitive demand of tasks and questions is the work of Neumann and Mahler (1989). They investigated the cognitive congruence in questioning (the degree of cognitive match between the questions asked by the teacher and the learners' answers), and found a significant mismatch: the questions were not stretching the pupils' thinking abilities. The teachers' questions functioned at the task level (that is, management, procedural, factual recall) not at the cognitive level (requiring higher order thinking skills).

It has been suggested for some time that the questions teachers ask are more about controlling communication than influencing the learning (Gall, 1970; Dillon, 1982; Newton, L., 1996; Rodriquez and Kies, 1998; Shaunessy, 2000). Closed or factual questions enable teachers to retain control. They ensure progression on the teacher's terms, the role of the learners being that of a respondent in the communication slots allowed by the teacher. Such control restricts the cognitive freedom of the learner. More demanding questions may reduce the teacher's control of the content, direction of the lesson, and even (if they don't have all the answers) the teacher's self esteem.

Research has, however, shown that children's thinking and problem solving abilities improve when teachers use higher level questions (e.g. Blosser, 1973; Andre, 1979; Redfield & Rousseau, 1981; Koufetta & Scarfe, 2000). These questions are usually considered to be those that ask for higher levels of cognition (as defined by various taxonomies, such as that of Bloom (1956) or Anderson and Krathwohl (2001)). The questions require mental actions, like evaluation or synthesis of information and knowledge. More recent work found that *What*

if...? and *Why…?* questions stimulate creative and critical thinking which, if followed by more probing questions to encourage application in new contexts, support the development of ideas and the construction of understandings (Fredericks, 1991; Kazemi, 1998). These findings were confirmed by Newton, L., (1996) in a study of teachers' questioning. Willig (1990) also suggests that skilful questioning lies at the heart of a cognitive conflict strategy. In education, this is a term used to describe when a learner feels mentally uncomfortable because new ideas or information contradict or conflict with existing information, ideas and beliefs. This cognitive discomfort – dissonance or conflict – can be managed through the teacher-pupil interaction in the classroom, particularly dialogue and questions. This, of course, is fundamental to Vygostsky's (1978) social constructivist perspective, with scaffolding across a zone of proximal development (the ZPD) by a more knowledgeable other (usually the teacher). Transit across the ZPD moves the learner from what is already known to the unknown with scaffolding of experiences and activities. Hardman (2008) notes that:

> *Vygotsky suggested that using language to communicate helps in the development pf new ways of thinking: what children learn from their 'inter-mental' experience (communication between minds through social interaction) shapes their 'intra-mental' activity (the way they think as individuals.* (Hardman, 2008, p. 134)

For Wilig (1990), skilful questioning can be used by a teacher to make children reflect upon their ideas and their reasons for holding those ideas. In other words, the skilful questions are part of the scaffolding strategy. But do teachers understand what skilful questioning requires? Whatever the potential of skilful questioning, however, it is academic if they are, nevertheless, often absent in the classroom.

A difficulty here is the under-pinning assumption that higher-level questions elicit higher cognitive level answers. Even when questions relating to the higher levels of taxonomies are asked, Dillon (1982) found that higher order responses do not automatically follow. Any question narrows the options available to the respondent, limiting the field of thought to that intended and expected by the questioner. The degree of restriction depends on the type of question, the degree to which the questioner and learner share common knowledge and experiences, and the extent to which the questioner is in a real position to evaluate the answer. This emphasises the importance of contexts and shared meanings for question asking and answering. Researchers have tried to assess the cognitive level of the questions or have focussed on the interactional, as well as cognitive, effects of open and closed questions (Call, 2000). There have been numerous attempts to produce classification systems or taxonomies which teachers might use. Many of these systems suggest a hierarchy from lower level/order questions to a higher level/order. Generally, the former are concerned with simple factual recall or basal comprehension, while the latter involve understanding, meaning making, reasoning and thinking. Yet teachers seem to be unaware of such taxonomies or do not use them (Dillon, 1990).

An additional difficulty, hopefully temporary, is that learners who have been subject to years of questions demanding only recall may have developed the habit of responding in this way. Questions which call for more thought and the construction of a coherent and extended response, call for more mental effort and may be unwelcome.

4.2 Asking Focused Questions

Simply tying questioning to particular levels in taxonomies or frameworks is not always of great practical benefit. Asking questions at any particular taxonomic level without regard for what is going on in the learner's mind is unlikely to be as productive as it could be. It is not a matter of one kind of question being better than another but of recognising kind is needed and knowing how to use it to good effect and follow it productively with others. Planning for questioning can help with this process. This is represented in a cycle, shown in Figure 4. Note this is an example of one possible cycle that can be used to help planning for focused questioning – there may be others.

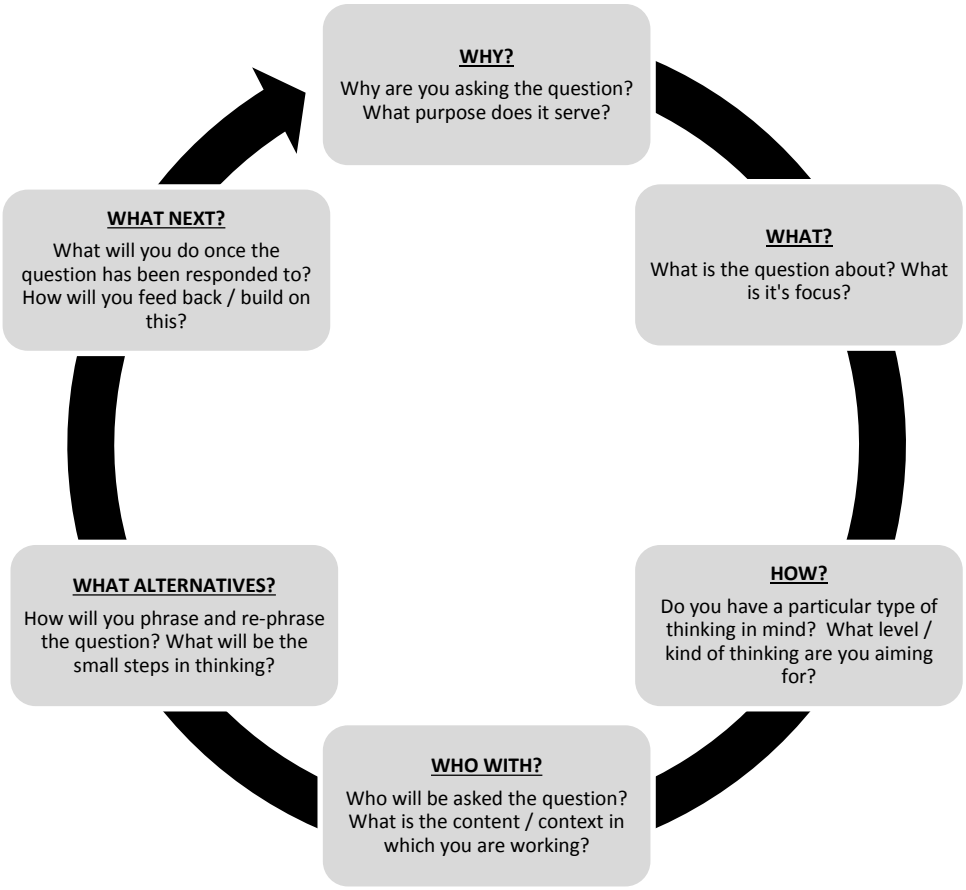


Figure 4: A questioning cycle

Teachers need to ask:

Why? – Why am I asking the question? What purpose does it serve?

What? – What is the question about? What is the content on which I am working? Is it targeted or focused on, for example, a concept or an idea or a prior experience?
How? – Do I have a particular type of thinking in mind? What kind and/or level of thinking am I aiming for?
Who with? – Who will be asked the question, a specific child, group or the whole class? What is the context in which I am working, for example, revisiting prior experiences or enhancing an experience?
What alternatives? – How will I state and re-state the questions? What will be the small steps in thinking, for example a series of sub-questions?
What next? – What will I do once the question has been answered? How will I feedback / build upon this learning?

For Martens (1999) productive questions are those that help teachers to bridge between the learning task and the learner. The focus of Martens' productive questions is on:

- attention-fixing;
- measuring and counting;
- comparing;
- action-generating;
- problem-posing; and,
- reasoning.

I prefer to call them focused questions because this indicates more clearly that they are tailored to the particular needs of the learning situation, and these vary from learner to learner and lesson to lesson. In any learning situations there may be episodes of, for instance:

- tuning children's attention to the task in hand;
- eliciting prior knowledge;
- developing or supplementing that knowledge;
- developing a grasp of the new situation;
- highlighting significant relationships;
- setting the scene for activity;
- consolidating learning;
- articulating ideas;
- developing and using learning;
- applying ideas in new contexts; and,
- deepening and widening learning.

What is productive in any one of these episodes may be different to what is productive in another and so the *type* of question is not always a useful guide to the best question for a particular purpose. Take, for example, *"How...?"* questions. *How...?* as a process (as in, *How did you measure the distance?*) cannot be distinguished from *How...?* as a fact or quantity (as in, *How far is it?*). Of course, this will also depend upon the language of instruction, in that nuances in different languages might affect the interpretation for children who are working in a second language. However, when the focus of the question is included, the outcome

changes. *What was the name of …?* and *How did we …?* questions function to elicit prior knowledge and understanding, the former of factual information and the latter of procedures. *What happens if …?* and *How might we…?* questions ask for predictions that exercise knowledge and understandings gained from prior and current experiences. All are useful productive questions but are more effective in their use if focused on particular stages in a lesson. Recall of prior experiences to set the scene for new experiences would work well at the beginning of the lesson. Extension and application questions focus attention on the new experiences and require learners to connect ideas and construct new understandings.

The same kinds of questions can be used for different purposes in different parts of a lesson, as illustrated in Figure 5. This takes a typical lesson structure, with four parts: an introduction, a content development component, some activities on the part of the learners, and a plenary. The possible purposes of each part are exemplified and the, for each part, some possible question starters are provided. It is feasible to have the same question starters in different parts of the lesson.

Question Purpose	Question Types
[1] Ask questions which: - set the scene for the new unit of work - engage student interest - make the relevance explicit	Do you remember ...? How many of you have ...? What happens when ...? Have you ever ...? Who knows about ...? Did anyone see ...?
[2] Ask questions which: - recall relevant prior knowledge - ensure the learners have the necessary prior knowledge to work with	What did we do ...? Can you remember how ...? What does ... do when ....? What is a ...? Why did ... happen? How did you ...? What happened when ...?
[3] Ask questions which: - set expectations for the lesson - lt the learners know what they are expected to do mentally as well as physically - guide learners towards what is relevant - focus on task / topic	How can you ...? What do you think we could do to ...? What we need to find out is ... so what ....? What happens when ...? How do you think we might ...? Does it matter which ...? Why should we ...?
[4] Ask questions which: - use the learning in new situations - make connections - apply ideas in new contexts - use learning to predict - explain ideas to others	How is this like ...? What will happen if ...? Can you explain...? Why is / does ...? What if ....? What would ...? Why is it important to ...?

Figure 5: Question Purposes

Such a focusing of questions – choosing, shaping and using questions - is intended to stimulate more precisely the active thinking that is needed at a given point in the lesson. Supporting learning through questioning, therefore, involves a sequence of tailored questions, each helping the child over a particular mental obstacle. Of course, not every topic will present the same opportunities for, or obstacles to, thinking, so the pattern of focused questioning cannot be rigid. Lustick (2010) suggests that using quality focused questions enables learners to engage in authentic inquiry about relevant phenomena, which is of benefit both to teachers and to learners by fostering curiosity and enriching understanding of content. This is inherently inquiry-based learning, calling for problem solving and creative thinking (Newton, L., 2012). Do we encourage teachers to do this?

The beginning of this productive, higher-order thinking is understanding. A traditional view of understanding is one of *"How much?"* - an additive view. New learning (facts, ideas, information, ...) is added to what is already known. More contemporary views see understanding as the construction of mental models of situations or experiences, with new ideas being related to each other and integrated into the existing mental structures to build something new or more comprehensive (Newton, D., 2012). Perkins (1992, p.31) argued that, *'Learning is a consequence of thinking.'* To this can be added that quality thinking can be a consequence of quality questioning.

4.3 Developing Teachers as Skilful Questioners

Most children know the question and answer game from a very early age. Taylor and Taylor (1990) noted that very young children can distinguish questions from non-questions, and *yes-no* questions from *wh*-questions (questions that start with 'wh-'), based on intonation, the presence of key words and sentence structure. Even 2-year-olds are able to do so, although not always responding appropriately. Berninger and Garvey (1981) found that yes-no questions evoked relevant responses from all the 3-year olds tested, but certain *wh*-questions evoked irrelevant responses from them. Some *What...?* and *Where...?* questions were easily answered by them using pointing words, such as *that* and *there*, and often questions were answered with offers of demonstration, such as, *'I'll show you.'* However, *Why...?* questions require answers that involve formulating cause and effect. Berninger and Garvey found younger children unable to handle these. By the age of 4 years, Wells (1986) found most children studied were enthusiastic question askers, passing through a phase of perpetually asking *Why...?* questions as they strive to make the world meaningful, although many parents found answering these *Why...?* questions difficult and soon ended the conversation and the child's urge to ask such questions.

A further consideration is pointed to by McGregor (2006). This is the relationship between metacognition and questioning. Drawing on the work of researchers such as Claxton (1999) and McGuiness (2005) she provides a discussion on the importance of questions that prompt learners to reflect on their mental processing as they work towards solutions. They recommend teachers scaffold the process with appropriate questioning. The problem is in defining for teachers what is meant by *appropriate* questioning and helping teachers to

question skilfully. Based on what has been said, *appropriate* questions are those which match the learning needs of the students and move their learning forward.

Brown and Wragg (1993) provide a list of tactics for the teacher for what they call effective questioning but could also be thought about in terms of appropriateness. They advise that teachers need to think about:

1. Structuring - *Planning what to ask, when and why.*
2. Pitching and putting clearly – *Keeping questions simple and matched to need.*
3. Directing and distributing – *Making sure all are involved in the process.*
4. Pausing and pacing – *Giving sufficient thinking time.*
5. Prompting and probing – *Having alternatives ready to support and push thinking on.*
6. Listening and responding – *Listening to answers and being positive.*
7. Sequencing – *Making sure not to overload or ask inappropriate questions.*

This list of tactics reminds us that skill in questioning is not just about creating the *right* question - it also involves *interpersonal* skills, as pointed to by Chin (2007). She explored the use of questions by teachers to develop students' thinking and from her analysis of the dynamics of the interactive relationship with 11-12 year olds, she identified a number of enabling strategies relating to teacher questioning and feedback:

- avoidance of explicit evaluation or put-downs;
- acknowledgement of the students' contributions;
- re-statement of student responses; and,
- ability to pose follow-up questions that build on the earlier responses and stimulate cognitive processing.

The first three of these are largely interpersonal in nature, requiring the teacher to think about the interaction between him/herself and the learner as part of that teacher-learner communication process that is the learning dialogue. Chin also noted that all strategies appeared to promote productive talk rather than mere rote recall responses. She advocates the need for teachers to:

> *... position themselves as enablers of talk for thinking* [through the deliberate use of] *...meaningfully related questions that stimulate students to tap into higher-order thinking processes.* (Chin, 2007, pp.1343-4)

4.4 Developing Pre-Service Teachers as Skilful Questioners

A starting point for helping teachers to position themselves as *enablers* for thinking might be to focus upon what is done on programmes that train or further educate teachers about skilful questioning. Is it taught and developed sufficiently? Anecdotally, programmes that prepare trainee teachers (pre-service teachers) for their teaching career often introduce questioning strategies and advise on how questions can be used to achieve and assess learning outcomes, but are those learning outcomes specifically linked to high quality thinking on the part of the learner? Some programmes seem to explore thinking, but not necessarily the concepts associated with productive thinking, or link questioning to thinking. Pre-service teachers need

to be introduced to a rationale for teacher-question asking, which shows how it sites within the broad framework of a teacher's communication repertoire (for example, through general talk, instructional talk, or class or group discussion). How focused questioning fits into this repertoire needs to be explained, practised and developed, perhaps with an *aide memoire* to think with as with the cycle shown in Figure 6. In essence, such a cycle encourages the teacher to think about the purpose of the question, to focus it and locate it according to the learning needs. If it is also linked in to planning, with learning outcomes that include productive thinking, then the two – questioning and higher level thinking – are brought together.

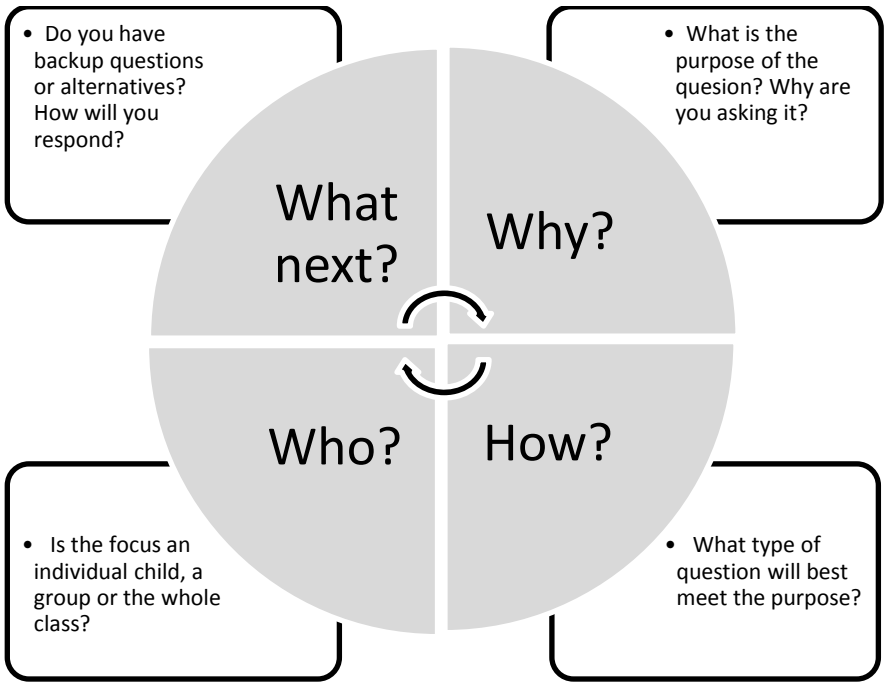


Figure 6: A focused questioning cycle

It would also be appropriate to raise awareness of how other disciplines are informing our ideas about questions and thinking with pre-service and experienced teachers. For example, some interesting work from neuro-linguistics by Phillips described by Greenleaf (2006) considers research on eye movement and thinking in response to a question.

> *When a question is asked, or an individual simply is in thought, the illustrated movements indicate the area of the brain accessing information. Thus, if you ask one a question about the past (recall), and she looks upward to the right in generating a response, she is likely to be "creating" the answer, rather than reciting it from memory. Similarly, looking horizontally to the left is indicative of recalling familiar sounds of the past that have been stored and recognized.* (Phillips, described in Greenleaf, 2006, p.103)

Such bodily indicators of the kind of thought going on in the learner's head are, potentially, useful to a teacher, and may be added to in the future.

Levine (2007), in his work *All Kinds of Minds*, provides an overview of neurodevelopmental constructs: attention; temporal-sequential ordering; spatial ordering; memory; language; neuromotor functioning; social cognition; and, higher order cognition. For each of these constructs he then provides an explanation of terms. Of relevance here is his final construct, higher order cognition, which he breaks into the sub-constructs and explains as:

- concept formation (verbal; non-verbal and process)
- critical thinking
- creativity / brainstorming
- problem solving
- rule use / sensing irregularity
- reasoning / logical thinking
- mental representation.

These can be directly related to the productive thought framework presented earlier in Figure 2 (on p. 15). Again, the relevance of these neurodevelopmental ideas for classroom practice, and the need for the teacher to think about the learning needs of his or her students, can be appreciated.

5. In Conclusion

Willig (1990) suggested that what counts is not so much the kind of questions asked but rather the strategy of skilful questioning used by the teacher. But what exactly is skilful questioning? I see it as that which addresses the needs of the immediate learning situation and help learners exercise and develop the kind of productive thought that is desired. Understanding and reasoning, problem solving and creative thinking, evaluative and critical thinking, ethical and moral thinking - these reflect the realities of high quality teaching and learning. This is skilful questioning with a focus, the focus being the nurturing and development of productive thought. Such questioning cannot be a mechanistic process that follows a recipe from a taxonomy or a framework. Rather, it is one that requires the mental engagement of the teacher with the learners' thinking, as well as that of the learners' engagement with the topic. Both the kind of questions asked and their focused deployment matter.

For the teacher, decisions must be made in action but this does not mean that questioning is entirely an on-the-spot construction. Forethought and planning can prepare the teacher for the interaction and ensure that there is a clear progression that focused questions will support. A collection of prepared questions is a useful resource. For those who lack confidence in the subject, prepared questions and a good textbook will be a re-assuring aid, although the book may more use as a source of subject or pedagogical knowledge than as a model for focused questions.

A final point is to do with the training of teachers to ask questions. Training teachers can make a difference. Research has shown that the effect of spending time training teachers can be significant, improving their questioning skills and outcomes in terms of gains in student achievement (Redfield & Rousseau, 1981; Gliessman *et al*, 1988). Interestingly, Redfield and Rousseau also showed that a mixture of lower and higher level questions was more effective in generating deeper understanding. Working in the USA, Lustick (2010) found that the questions used by teachers to foster reasoning are likely to be taken from a textbook, laboratory manual or a worksheet. As such, they are generic, not even class-specific, let alone learner-specific. He recommends the use of more focused questions and emphasises the need for those delivering pre-service programmes for teachers to be:

> *... exposed to a more robust discussion about the quality of focus questions beyond that of higher or lower thinking and open or closed construction.*
>
> (Lustick, 2010, p. 508)

He proposes a focus question framework for teachers to use in science with pupils across the K-12 age range but emphasises the need for teachers to know more about the topic of questioning and develop the skills needed to exhibit focus questioning behaviours consistently. The consequence of such exposure would, according to Lustick:

> *... translate into more engaging, interesting, and memorable learning experiences in future classrooms. By developing and incorporating science questions that promote sustained reasoning through inquiry, classroom teachers can help learners foster deeper understanding of science content and an appreciation for the scientific enterprise.* (Lustick, 2010, p.508)

In short, developing focussed questioning skills in teachers to encourage productive thinking in learners is not a forlorn hope but is a feasible enterprise.

In conclusion, teachers ask a lot of questions but they do not always use them to good effect. To help teachers overcome this, I have proposed the notion of focused questioning. Focused questions shape and directs questions to foster the kind of thinking needed at a particular stage in a lesson or students' learning experiences. For this, a teacher needs to think less about the general use of questions or the application of taxonomies and more about the next step. What do they want to see in the students' thinking? Is it recall or deduction, understanding or creative thinking, decision making or evaluative thinking? By not doing so, they risk ignoring Vygostsky's Zone of Proximal Development (ZPD) and the scaffolding needed to move into and through the zone. Focused questioning with productive thinking at the focal point can aid this scaffolding.

Moore (2008) tells us that:

> *It is necessary, and even desirable to provide students with a sound education in basic skills. A complete education, however, must emphasize thinking skills that enable students to function responsibly and to solve problems in ways that are sensitive and caring of others, society, and the world.*
>
> (Moore, 2008, p. 312)

By delivering skill in focused questioning, a teacher has a means of achieving this end.

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Abstract (for the back cover)

‘*Questioning opens up possibilities of meaning*.’ (Gadamer, 1993, p.375)

The potential of questioning to support learning is widely recognised. When teachers ask questions, they assume the questions are doing something useful. This could be the reason why research tells us that teachers ask a lot of questions. Sometimes, lessons I have observed seem to be nothing but questions. Yet people like Wahlberg (1984) and Hattie (2009) found questioning to be only a mid-range strategy for effectiveness. So why is this the case? I argue that the answer lies not in the quantity of questions asked but their quality and focus. Are they fit for purpose? Do they support rich learning environments in which the students can develop not only their skills, knowledge and understanding in relation to the curriculum content they are exploring, but also their ability to think purposefully and productively? This raises the question: How can we, as teachers and educators, use questions and questioning strategies to foster productive thought in academic contexts? This monograph explores these ideas and presents a model for focused questioning.