Chapter 2
The Heuristics of Effective Teaching

2.1 Establishing a Useful Frame on Pedagogy: The Core Principles of Learning

Pedagogy is a much used term by educationalists and other personnel in the learning industry when talking about matters of curriculum, teaching and learning. No matter how many curriculum-related meetings I participate in, I am still amused by the plethora of terminology that surface in this area (e.g., pedagogical approach, pedagogic practices, pedagogical content knowledge and, more recently, signature pedagogies). However, what is equally apparent is that for many there is still a high level of conceptual confusion. This was recently highlighted by being asked specifically by a course manager, "Is there one pedagogy or many and, if so, how are they best categorized?" This can be explained as just another consequence of periodic radical reframing of what constitutes good teaching, as outlined in Chap. 1. It is not surprising that people are confused, because there *is* confusion. This chapter will seek to reduce some of the confusion and, more importantly, offer a pedagogical framework that is firmly grounded in the increasing evidence bases relating to how humans learn and what teaching methods actually work best and why.

Historically the term pedagogy seems to have been derived from the Greek words *paid*, meaning "child" and *agogus* meaning "leader of." This essentially frames pedagogy as referring primarily to the teaching of children. Mortimore (1999), in a comprehensive review of the literature on pedagogy, noted that approaches to pedagogy have gone through various phases, focusing on such aspects as 'teaching styles', 'paradigms of learning', 'models and methods of teaching' and 'the context of teaching'. He, not surprisingly, concluded that:

> Pedagogy has been seen by many within and outside the teaching profession as a somewhat vague concept. (p. 228)

D. Sale, *Creative Teaching*, Cognitive Science and Technology,
DOI 10.1007/978-981-287-534-1_2

More recent definitions (The Free Dictionary 2014) have dropped the reference to child and applied it more generically to "the principles, practice, or profession of teaching" or "the activities of educating or instructing." Pedagogy has also been contrasted with the term *andragogy* (Knowles 1984), which focuses on the teaching of adult learners. Invariably, this in itself has led to further confusion: do adults learn differently from children and should they be taught differently and in what ways, how?

Certainly there are significant differences in the level of prior experience of adults, as compared to children. Adults also choose what they learn and this is typically consciously directed to meet work or personal learning goals. Kids at school are largely told what to learn, at least in the earlier years. However, whilst there are important motivational and life experience differences for adults, it is questionable whether the underlying learning process is structurally different from that of children who have attained the stage of formal operational thought (Piaget 2001), typically around 12–15 years of age. At this stage of brain maturation, children are able to reason logically and use a range of thinking skills (e.g., analyze, compare and contrast, make inferences and interpretations, evaluate). In some ways, this has similarities with the notion of different learning styles, which was popular in the educational literature for a couple of decades. As outlined in Chap. 1, research has far from validated such theories and, in particular, their usefulness in terms of pedagogically useful applications. I agree with Schank (1997) who argued that:

> Contrary to common belief, people don't have different learning styles. They do, however, have different personalities. The distinction is important, because we need to be clear that everybody learns in the same way. (p. 48)

A similar inference and interpretation is made by Goulston (2009), who argued that:

> While our lives and our problems are very different, our brains work in similar ways. (p. 3)

While philosophical discussions on how best to frame pedagogy will inevitably continue and this is important in critical educational discourse, it has limited usefulness for busy teaching professionals seeking practical guidance on how best to design highly effective learning experiences and conduct their teaching practices skilfully. As indicated in the previous chapter, we are now in a position to frame a more cohesive evidence-based pedagogy that can provide the essential validated professional knowledge base for guiding practice. The present scenario is analogous to completing a large complicated jig-saw puzzle, and we don't have all the pieces (some are clearly missing). However, we have enough pieces and the intelligence to construct a sufficiently useful picture of what effective and creative teaching entails, and what is required for successful enactment in practice. It is useful to have strong empirical evidence that teachers make the most significant difference (positive or otherwise) in terms of student attainment levels and student's lives. However, it is even more essential to go much further and be able to evolve valid and practical pedagogic models of how the most effective teachers actually do this at the level of

experience design. It is only from an evidence-based approach can we produce professional development programmes which have high predictability in terms of improving teaching practices and student attainment levels. Similarly, Hattie's (2009) summary of differential teacher proficiency is salient in this context:

> Not all teachers are effective, not all teachers are experts, and not all teachers have powerful effects on students. The important consideration is the extent to which they do have an influence on student achievements, and what it is that makes the most difference. (p. 34)

As outlined in Chap. 1, much has been learned about the effectiveness of different methods of teaching and strategies of learning and their impact on student attainment. The big questions now centre on what makes such methods and strategies work better and how they operate in terms of productively structuring the subjective experience of learners. To put it in most simple terms, what specifically goes on inside students' heads and how does this enhance their learning processes, resulting in better attainment? The more we frame better evidence-based answers to these questions, the more we move towards a *pedagogy* that is practically useful in terms of how we teach, and all that this entails.

In the following sections of this chapter, through an extensive synthesis of a wide range of knowledge bases relating to human learning, I outline and illustrate certain key heuristics or *Core Principles of Learning* that underpin highly effective teaching. Together they constitute a pedagogic framework from which teaching professionals can thoughtfully plan learning experiences from a more evidence-based perspective. The framework does not claim to be exhaustive or summative as new knowledge and insights will continually enhance our understanding of human learning and the implications for how we teach. However, from much validation in practice across a wide range of educational sectors and cultural contexts, I see them as contributing to a much needed ***Pedagogic Literacy***.

Furthermore, while each Core Principle of Learning focuses attention on a key area or process relating to how humans learn and the specific implications for planning instruction, they are not discrete or separate in that they should be considered independently of each other. In fact, they are mutually supporting, interdependent and potentially highly synergistic. As Stigler and Hiebert (1999) highlighted:

> Teaching is a *system*. It is not a loose mixture of individual features thrown together by the teacher. It works more like a machine, with the parts operating together and reinforcing one another, driving the vehicle forward. (p. 75)

2.1.1 Core Principle 1: Motivational Strategies Are Incorporated into the Design of Learning Experiences

Motivation initiates, directs and maintains all human behaviour. It is inseparable from learning in that without some motivational base, limited attention and effort

will be given to that area of human activity. Indeed, as Sylwester (1998) pointed out:

> It's biologically impossible to learn anything that you're not paying attention to; the attentional mechanism drives the whole learning and memory process. (p. 6)

In a similar vein, Csikszentmihalyi (1990) argued:

> The shape and content of life depends on how attention has been used….Attention is the most important tool in the task of improving the quality of experience. (p. 33)

Motivation and attention are very much connected in the world of the classroom, as in all areas of human activity. When learners are motivated, they are much more likely to give a higher level of attention than in situations when motivation is poor. They are also more likely to put effort into the learning process, especially when difficulties are encountered. As a result, and this is fairly obvious, motivation and effort over time, especially if supported by a good teacher, typically results in better learning outcomes. This provides the basis for further motivation, as well as enhancing confidence. Over time increased mastery is likely to be achieved and, many years down the line, even expertise.

However, while motivation is recognized as fundamental to learning, there is much debate about how it works and, more significantly, how we as teachers can harness such human energy in the pursuit of educationally desired learning goals. The literature is rich in terms of theories and models of human motivation (e.g., Maslow 1962; Herzberg 1966; Deci and Ryan 2002; Dweck 2006), but I have some empathy with the frame of the management guru Peter Drucker (1999) who made the challenging assertion that:

> We know nothing about motivation. All we can do is write books about it.

Indeed, this may seem to have a fair measure of face validity at least in terms of widespread practice in educational institutions, as Levin (2008) concluded:

> …boredom and lack of engagement remain endemic in schools around the world, and seemingly unmotivated students are a main complaint of teachers. (p. 99)

Certainly, whatever the underpinning bases of human motivation entail, especially in the context of the school environment, there seems to be a real problem which has not been sufficiently addressed to date. For example, Wagner (2010) made the point that:

> In countless focus groups I've conducted with high school students, "boring classes"-which include so-called advanced classes – are among the main complaints about school. (p. 114)

What then can we really establish as an evidence-based frame on human motivation, as compared to what we might like to believe it is? On many occasions I have heard teachers being told by various sources that they should ignite the passion for learning in every child. A nice ideal and it should be a goal we seek to attain. However, it's a bit like saying doctors should be able to cure all diseases and

sickness, and this may be a goal that many seek. I would particularly like that, especially if they can reverse the ageing process also. However, it's not the world as I know it. The evidence would also support this, as people are still getting sick and dying. Referring back to motivating students—is it really possible to ignite a passion for learning in all? Well, I'm going to play my 'get out of jail' card (this is a card used in the game of Monopoly to enable your moving counter icon to immediately get out of jail when it unfortunately, through the throw of the die, lands on a space that denotes 'Go to jail'). I really don't know the answer to the question, and I'm not sure there is one. It is similar to asking the question of whether or not people are born basically *good* or *neutral* in terms of dispositions, or are some simply badly wired to be difficult or even dangerous? The nature-nurture argument is far from settled, as Pinker (2002) documents in The Blank Slate: The Modern Denial of Human Nature.

However, while we might like algorithmic answers to our big questions, whether it's how best to motivate our students or other areas of life that are meaningful to us, in reality we may have to settle for a well framed evidence-based set of useful heuristics; otherwise we may simply go with personal preference, albeit more philosophical than empirical. In most basic terms, from my experience, I would not dispute the English Philosopher Jeremy Bentham's (1789) framing of human motivation in terms of:

> Nature has placed mankind under the governance of two sovereign masters, pain and pleasure.

Invariably, what is pleasure to one person may be pain for another, but little in my life has seriously questioned the underlying premises. Indeed, such a perspective, with some additional components (e.g., novelty) has been supported from the field of cognitive neuroscience (e.g., Cloninger 1997). In educational contexts, few would disagree that students who perceive classroom learning as painful and boring are unlikely to contribute much, except to absenteeism rates and disruptive behaviour. The converse is also true. When students experience the learning as personally interesting, or place value on the qualification to be obtained from successful completion of a programme, they are more likely to participate meaningfully in the learning activities. For many adult learners, there are clear goals associated with their learning. These may have both extrinsic and intrinsic components. Extrinsic motivation typically refers to the motivation coming from external factors to the activity (e.g., money, status or power, rather than the specific work activity). In contrast, intrinsic motivation is where motivation is derived from doing the task itself (e.g., passion for teaching). For example, having conducted more than 100 teacher education programmes, it was apparent that many participants had joined the programmes largely for purposes of accreditation (e.g., no certificate, no job). However, even for such extrinsically motivated persons many did, over the duration of the programme, find intrinsic interest which resulted in added value to their overall learning experience.

Where there are strong extrinsic motivators, it is always likely that learners will try to maintain a level of attention to achieve success on the programme (typically

certification). Even for non-adult learners, grades and passing the examinations are strong extrinsic motivating anchors. However, for many pupils, there may be limited extrinsic motivators (e.g., passing exams for the school subjects does not get them a desired job) as well as little or no intrinsic interest in school subjects. This makes teaching such students highly challenging and potentially frustrating. It is in this situation that the competence and creativity of teachers is really challenged. Have you been there? If so, I need to say no more. You will also know what a really significant difference you can make.

Motivation is influenced by a wide range of interacting factors, such as cultural values, personal beliefs, perceived usefulness and interest in the learning or what it will lead to. In the absence of strong external motivators, interest is fundamental to motivation. We actively seek to do stuff we like. It's as simple as that. Whitehead (1967) puts a nice spin on this:

> There can be no mental development without interest. Interest is the *sine qua non* for attention and apprehension. You may endeavour to excite interest by means of birch rods, or you may coax it by the incitement of pleasurable activity. But without interest there will be no progress. (p. 37)

Students who believe that the learning experience may result in satisfying some aspect of personal need (whether consciously or subconsciously) are more likely to participate meaningfully in the learning process. Equally important in the motivation stakes is to what extent students actually believe they are able to achieve their desired goals. Schunk and Zimmerman (2008) found that:

> The self-efficacy beliefs that students hold when they approach new tasks and activities serve as filters through which new information is processed. (p. 118)

For example, Bandura (1997) observed that students who believed they were capable of meeting desired goals (self-efficacy) were much more likely to take on the required learning tasks, put in the necessary effort and achieve success, than those who lacked self-efficacy. In contrast, students who believe that they lack the capability or intelligence to achieve goals are much less likely to put in the necessary effort, especially when the learning gets tough. However, as we know, new learning is often tough and this is especially the case when one is a novice in that skill area. Without a strong belief that the desired learning is attainable, the perseverance to continue in this situation can quickly wane, with a likely outcome of rapidly terminating attention and effort for this particular learning activity. Hence, limiting beliefs about one's capability can easily become a major systemic barrier for future learning, as they often result in a self-fulfilling prophecy. Merton (1948) developed the notion of 'Self-Fulfilling Prophecy' and its implications for person perception and subsequent behaviour, aptly captured by W.I. Thomas (sometimes referred to as the Thomas theorem), "If men define situations as real, they are real in their consequences." Merton points out that:

> The first part of the theorem provides an unceasing reminder that men respond not only to the objective features of a situation, but also, and at times primarily, to the meaning this

> situation has for them. And once they have assigned some meaning to the situation, their consequent behaviour and some of the consequences of that behaviour are determined by the ascribed meaning. (p. 194)

He goes on to suggest that:

> The self-fulfilling prophecy is, in the beginning, a *false* definition of the situation evoking a new behaviour which makes the original false conception come *true*. The specious validity of the self-fulfilling prophecy perpetuates a reign of error. For the prophet will cite the actual course of events as proof that he was right from the beginning. (p. 195)

In most basic terms, our thinking and consequent behaviour is largely based on the 'pictures in our heads' and if they are *poor* pictures, the consequences may turn out just that way also. Fortunately, they are changeable based on new experience which is hardly surprising, if we think back to what we believed to be true as children. Do you really still believe in the 'tooth fairy', Santa Claus, or the bogeyman under the bed? As Adler (1996) cleverly noted:

> We forget that beliefs are no more than perceptions, usually with a limited sell by date, yet we act as though they were concrete realities. (p. 145)

For example, in this context, Dweck's (2006) extensive research on students' beliefs (mind-sets) relating to intelligence has profound implications in terms of motivation, how students subsequently approach their learning and for how teachers teach (see Fig. 2.1: Comparison of Fixed and Growth Mind-sets). In summary, she contrasted two fundamentally different mind-sets, relating to how students approach learning, a *Fixed mind-set* and a *Growth mind-set.* Students who possessed a fixed-mind-set tended to see intelligence as a stable genetic quotient, and as a consequence you are either smart or you are not. In contrast, students who possessed a growth mind-set saw intelligence as a more fluid entity, reflecting effort and hard work, and a capability that can be developed and enhanced. To quote Dweck, a growth mind-set:

> … is based on the belief that your basic qualities are things you can cultivate through your efforts. Although people may differ in every which way – in their initial talents and

Fixed Mindset (Intelligence is static)	**Growth Mindset** (Intelligence can be developed)
Leads to a desire to look smart and therefore a tendency to: • Avoid challenges • Get defensive and give up when faced with obstacles • See effort as something less able people need, and not for the smart • Ignore useful negative feedback • Feel threatened by the success of others	**Leads to a desire to learn and therefore a tendency to:** • Embrace challenges • Persist in the face of setbacks • See effort as the path to mastery • Learn from criticisim • Find lessons and inspiration in the success of others
As a result, they may plateau earlier and achieve less than their full potential	**As a result, they reach ever-higher levels of achievement**

Fig. 2.1 Comparison of fixed and growth mind-sets

Fig. 2.2 Beliefs as a filter on reality

> aptitudes, or temperaments – everyone can change and grow through application and experience. (p. 7)

It is not difficult to understand how beliefs profoundly affect the way people approach their learning and the subsequent impact on attainment levels. Beliefs act as major neurological filters that determine how we perceive external reality (Fig. 2.2: Beliefs as a Filter on Reality). In this way they provide the inner maps we use to make sense of the world around us. When we have a belief about something in our world, we act as though it is true. It is what is in our Inner Personal Map of Reality that determines our perception, emotional responses and orientation to people and things in the External World. While the External World is only knowable through our senses and therefore can never be fully ascertained in purely objective terms (whatever this is), our challenge as evidence-based teaching practitioners is to build increasingly more useful Internal Maps of how best to facilitate learning and attainment for *our students* (part of our External World) and improve the quality of their Inner Personal Maps of Reality through the ways we teach and interact with them. How this works, in specific teaching contexts, will be illustrated further in this and subsequent chapters.

What is of particular significance in this context is that it is not just a question of student's beliefs, and their subsequent impact on perception and behaviour, but also that of the teachers. Furthermore, as the impact of teachers is the single most important factor in influencing student attainment, how they communicate their beliefs about learning capability to students will impact significantly on how students frame themselves as learners. The impact of teacher expectations on learning and attainment has a long and rich history in the educational literature. A landmark study was that of Rosenthal and Jacobson (1968) who set out to empirically demonstrate, in an educational context, that one person's expectation of another's behaviour could come to serve as a self-fulfilling prophecy. In basic terms they hypothesized that if teachers had high expectations of certain pupil's progress, this, in itself, could contribute to their actual progress. They conducted an experiment at a public elementary school (referred to as 'Oak School') in which only the prophecy is varied experimentally, uncontaminated by other variables. Prior to the commencement of the experiment proper, all children in the school, grades (years) 1–6, were given the "Harvard Test of Inflected Acquisition", a standardised, relatively nonverbal test of intelligence. At the end of the summer of 1964, the classes having been pre-tested, 20 % of the children were selected by means of random numbers

and designated as academic "spurters"—referred to as "special" children by the authors. Teachers, when given the lists of names in their class, were told only that they might find it of interest to learn which of their children were about to bloom. All children were retested after one semester, after a full academic year, and after two academic years. The overall findings of the experiment, after one year, showed that the "control" children gained over 8 IQ points, while the experimental group —"special" children—gained over 12 IQ points. However, it was in the first and second grades that the effects of teachers' prophecies appeared most dramatic. In these grades 19 % of the control group children gained 20 IQ points or more, but of the special children, 47 % gained that much. The authors concluded that:

> When teachers expected that certain children would show greater intellectual development, those children did show greater intellectual development. (p. 82)

While there has been criticism of a number of aspects of Rosenthal and Jacobson's research design (e.g., Thorndike 1968; Snow 1969), their attempt to provide a rigorous experimental design to empirically test the hypothesis that teacher expectations did significantly impact student attainment levels opened up the debate on how these effects are socially produced through classroom interactions between teachers and students. Much is now known on how this works, with many subtle processes operating subconsciously. These will be identified and explored in terms of how they can be used in practice to enhance attainment in subsequent chapter sections. Certainly teacher's beliefs and expectations do significantly impact student learning and attainment, as Hattie (2009) concluded:

> There are differences in attainment gains relating to whether teachers believe that achievement is difficult to change because it is fixed and innate, compared to teachers who believe that attainment is changeable (the latter leading to higher gains). (p. 92)

Similarly, Marzano's (2007) research is of particular interest in terms of explaining how different aspects of human psychological functioning interact in terms of influencing individual's motivation to learn. His new taxonomy focuses on three internal systems, all of which are important for learning. These are summarized below:

- **The Self-system**—This relates to the set of beliefs (and related feelings) the student holds about his or her capabilities, the meaning attributed to the task in hand, along with the perceived likelihood of success
- **The Meta-cognitive system**—This relates to the higher level self-regulation of the student in terms of being able to monitor and evaluate his or her own thinking process (e.g., setting goals, monitoring progress towards these goals and adapting to difficulties)
- **The Cognitive system**—This is the system that reasons, and thinks in specific ways (e.g., analyses, compares and contrasts, makes inferences and interpretations, evaluates) with the information at its disposal, to achieve the desired goals.

When faced with the option of participating in a new learning project or activity, it is the Self-system which initially decides (whether consciously or

subconsciously) to give attention and then activates the Meta-cognitive and Cognitive systems to provide structure and direction for the appropriate learning strategies and skills to acquire necessary knowledge, build understanding and skills to move progressively to goal attainment. He found that teaching strategies that activated the Self-system had greatest effect on student learning, the Metacognitive system the next most effect, and the Cognitive system least, though it is still substantial. What this means is that it is the Self-system that activates the Meta-cognitive system, which actives the Cognitive system, which creates learning. In the ideal situation for effective learning we would like to get all systems fully 'up and running' towards meeting the demands of the desired learning goal. What we now can be reasonably sure of is that without a desire to meet a task's outcomes, belief in one's capabilities to attain the necessary knowledge and skill components and a perception of likely success, there is likely to be little effort to commit to task requirements. Quite simply, unless the Self-system is firmly activated, the other important systems are not likely to be working at anywhere near optimal levels.

There are a number of important implications for teaching deriving from this Core Principle of Learning. While motivation is something fundamental to human existence and its importance runs across all areas of human activity, there is still much debate concerning how best to motivate students in educational institutions. Hence, it is a fundamental overall consideration in planning the learning experience and how we teach, though we must always recognize that much can vary depending on the student groups we teach. On one end of the spectrum, we may have groups of learners who are intrinsically motivated and want to learn as much as they can from what we are offering. However, this does not mean that we can leave this out of our planning considerations. Even the most intrinsically motivated students can be de-motivated in the face of boring teachers, and this is probably an experience that most of us will have experienced at some time. In contrast, at the other end of the spectrum, we may have students who initially display little or no intrinsic motivation for school learning but, over a period of time with good teaching, can develop interest through new perceived meaning and usefulness in what is being learned, and increasingly become more motivated and successful learners.

First and foremost, the design of learning experiences must involve much more than the actual subject knowledge involved, but also ways to generate and sustain learner interest. As Wlodkowski (1999) argued:

> …if something can be learned, it can be learned in a motivating manner…every instructional plan also needs to be a motivational plan. (p. 24)

There are many ways to do this and, in its heightened form, this is a key competence of creative teachers. How this works will be explored in detail in Chaps. 4 and 5.

Secondly, as motivation is very much bound up with perception and beliefs, it is important to encourage and sustain a Growth mind-set among students, especially among those who have not experienced much mastery or success in their studies. Students need to have a direct experience that, with effort on their part and the support of teachers, meaningful and successful learning is a likely outcome. There

is another of those old sayings, "Seeing is believing", which suggests that students need to see how things work in order to change perception and behaviour. However, is this really enough for creating significant change in key beliefs? Seeing can be a major factor in bringing about change, but it is also often rationalized away by many people, resulting in the existing belief still being the 'status quo' as far as perception is concerned. What is needed is a more sustained total learning experience in which students set and achieve a meaningful learning goal, go through the learning process supported by a good teacher who facilitates their understanding of what is going on in terms of their thinking and behaviour and how this achieves success in meeting the goal. It's really important that students understand the key processes and attitudes of mind that support successful learning. This involves making the process of teaching and learning visible for learners, and helping to build the necessary understanding of what they need to do and how, should they want to learn effectively. As Hattie (2009) strongly argued:

> One of the important understandings that teachers need to have about each student is his or her ways of thinking. By this it is not intended to delve into learning styles (visual, kinesthetic, etc.), for the effectiveness of which there is zero supporting evidence, but to understand a student's strategies for thinking, so that he or she can be helped to advance his or her thinking. (p. 42)

The importance of good thinking is considered in detail in Core Principle 5: *Good thinking promotes the building of understanding*. In the present context, students having compelling and sustained experiences of increasing levels of mastery are much more likely to change limiting beliefs to more evidence-based frames on learning. This works, at the psychological level, by creating a type of cognitive dissonance (Festinger 1957) that leads to a reframing of this aspect of reality. For example, when people have an experience that is significantly at variance with previously held beliefs, this creates inner conflict as these disparate cognitions are inconsistent and there is a human need to resolve this in some way to restore equilibrium—to 'settle the mind'—so to speak. In these situations of inner conflict, a number of outcomes can occur has a result. Often, especially if the new perception is idiosyncratic or not particularly intense, it will be quickly rationalized away and the established belief is fully or largely retained as the main filtering structure on reality (e.g., the status quo is maintained). If it is more intense and impactful across the senses, it may result in either a complete reframe of that aspect of reality (e.g., a paradigm shift) or a new frame, which somehow accommodates both the existing belief and the new perception. As a 9-year old, I had such an experience of the latter. Living in Hoxton, in East London in the 1960s provided me with plenty of opportunities for football, but limited ones for fishing, which I also liked as a child. Most of the rivers and canals in the local vicinity were heavily polluted at that time, and fish were far from plentiful or desirable to catch in these environments. However, fortunately I had an aunt and uncle who lived in the more ecological balanced environment of Bath, a somewhat sleepy and rural city at that time. Most importantly, it had great fishing opportunities as the river Avon passed through the city centre. Previously my visits were usually accompanied by my parents but on this occasion, for the first time, they allowed me to make the train journey on my

own, sending me off from Paddington station in London to Bath Spa, where my aunt (her name is Ida) picked me up. On my first morning at their house, as Ida came into the bedroom to wake me up, she put her hand under the blanket and quickly pulled out an egg and said "Dennis you have laid an egg." Somewhat surprised I examined the egg (as a 9-year old might) and noticed something strange about it. It had no 'little lion' printed on it. All eggs I had seen prior had a small lion emblem printed on them (this was of course the company brand but I did not know about these things); this was the first time I had noticed an egg that had no little lion on it. Of course I was not stupid enough to think that I was a chicken, based on this one experience. On the following morning Ida again came into the bedroom to wake me up, but I was already fully awake and prepared to see how she did this bit of 'magic'. I watched her carefully, and sure enough she produced 'magically' 2 eggs this time (both with no little lion on either of them) from under the bedclothes. I could not work out how she did this, and during the day I remember feeling somewhat confused. I still firmly believed that I was not a chicken, and that chickens lay eggs and not humans. However, after this happened again the following day, I felt totally confused. Now, here's the punchline, I solved the cognitive dissonance by retaining my belief that I was not a chicken, but was able to take on the specific ability to lay chicken eggs—some nice cognitive work for a 9 year old! I was comfortable with this and my mind was then able to focus on the more important task of catching fish. However, the story did not end there, and it's worth finishing it for those who like to see the 'funny side' of life. On my arrival back to London at Paddington station, where my mother was waiting patiently for her son, she was not at all impressed when I immediately spurted out, "Mum, mum, you don't have to buy eggs anymore as I'm laying them." On arrival back home she immediately called Ida and it was very apparent that even though they were speaking in a Neapolitan accent (both grew up in the suburbs around Naples) my mother was not pleased. I understood very little of the content but still recognized something like, "What have you done to Dennis, he thinks he can lay eggs?" It ended with Ida telling me that it was all a trick and she planted the eggs while I was sleeping. Not exactly high end magic, but it worked on a 9-year old who had no knowledge of free range eggs.

In the context of education, the same scenario is likely to play out for a student who is experiencing new perceptions of 'I am developing a good understanding of this subject' but this is conflicting with an existing belief of 'I'm not bright enough to learn this subject'. There will be the same conscious and unconscious processes of conflict resolution. In most cases, certainly in my experience, if the sensory experience of the new perception is sufficiently strong and consistent over time, it will eventually replace previous limiting beliefs and lead to the necessary reframing of the basis of intelligence, as summarized above. For many years, I worked in educational institutions in which a majority of students had little belief in their intellectual capabilities, and perhaps even less in the usefulness of teachers to do much to help them. In this situation, the priority is to bring about some reframing in their perception of themselves as learners, and this can only be achieved ultimately through their achieving mastery in learning tasks meaningful to them. However, one must first get some positive reframing by them on you as a person, not a wider construct on teachers per se. In working with students who had generally negative

frames on schooling and teachers for many years, I learned that there is little benefit in trying to convince them of the value of paying attention and learning academic stuff. Also, there is even less benefit in showing annoyance or losing one's cool over their lack of interest towards any kind of academic learning. This only reinforces their existing perceptions and may even add some pleasure or novelty to the situation for them—not for you. Unless you can get their attention and build some rapport, it's going to be a tough time as Michelle Pfieffer learned in 'Dangerous Minds', 1995, an American drama film in which she faced a very challenging class, but eventually got their attention and this made the difference. You can watch the film to find out how.

This heuristic of effective teaching is fundamental to all aspects of planning learning experiences and the practices of teaching. It is also the area in which much creativity can be generated and applied as it offers almost limitless possibilities in terms of how teachers can maximize attention and variation in the learning process. This will be explored and illustrated further in Chaps. 4 and 5. Without motivational strategies we are left with dry content, which may just as well be accessed without any reference to professional teaching activity. Certainly, with increasing e-learning capability and, in today's classrooms where teachers are competing for student attention with 'other' activities available on their laptops, the ability to create intrinsically motivating learning experiences may no longer be a 'nice to have' creative teaching competence for the few who can do this. Instead, it will more likely become a necessary capability for the mainstream teaching force, and may become the essential differentiator in terms of teacher proficiency levels. This is a particularly challenging aspect of creative teaching in that, as Zig Zagler (2014) famously stated:

> People often say motivation doesn't last. Well neither does bathing – that's why we recommend it daily

Finally, on the subject of enhancing student motivation, don't forget yourself in this endeavour. As professional educators, while we are paid to do this challenging work, there is no harm, in fact, massive benefit, in enjoying the experience. There is little pleasure or novelty, and certainly considerable pain in teaching groups of unmotivated learners. However, when we have learners who show interest in what we are teaching (not necessary all the time), positively interact with us as human beings, and are successful in the attainment stakes, it is a highly rewarding experience, and it's why many of us do this job. As Levin (2008) summarized;

> Greater engagement is a vehicle that improves students' work and makes teachers' lives easier as well.
>
> …increased student motivation is very positive for teachers' experience of their work. (p. 99)

2.1.2 Core Principle 2: Learning Goals, Objectives and Proficiency Expectations Are Clearly Visible to Learners

I fail to recall much by the way of consciously ever considering any learning goals over my 15,000 h at school, beyond getting a regular place in the school football team. Even for this desirable goal, I had little idea of what I specifically needed to do to achieve it—except to be good at football. The physical education teacher never helped me to understand my limitations as a footballer and what I might do to enhance specific skill areas. Indeed my school life lacked an explicit structure for learning beyond the fact that I was supposed to be there. Truancy was taken seriously and one would be severely punished if caught playing truant (e.g., caning plus possible suspension). In terms of the subjects I studied (the word really does not fit well), I had little notion of what I should be learning in terms of specific outcomes and to what level of proficiency. When the exams came round I tried to memorize what I had written down in class. As a consequence, I had no benchmarks for my performance. It was a surprise and a delight when I passed those 'O' and 'A' levels.

A similar lack of direction flowed throughout my school life, even for the one time I had 'The Careers Interview'—seriously I can only recall one. There was no exploration of career possibilities, simply something like, "You should be able to get a job with the post office … and don't worry as long as you believe in God all will be ok." That was the reality for me. From Chap. 1 you may have noted that one teacher, Mr Remmington, did make a difference to my decision making, which resulted in me staying on at school for 'A' levels, with the intention of becoming an architect. I suddenly had a goal, and to my credit, I did achieve the necessary qualifications to pursue this end. However, as with holiday romances, without reinforcement, their prominence in terms of conscious attention starts to recede over time and typically abates. For whatever reason by the time I had received my 'A' level results, this particular goal seemed to have lost its potency, and I had no real sense of direction again. As for many young men in my situation in this context, attention was primarily focused on how to get some money to participate in the customary activities of my working peers. After all, my school-friends had long since left school and were going out to local pubs and clubs with money in their pockets. And there was a real motivational base to this—girls. For the next 6 months I worked as a labourer on a building site for the scaffolding crew. Scaffolders were a tough bunch of guys, and they had to be to carry those 22 foot poles—which were cast iron in those days. Anyway, the money was good, and my boxing background meant I could match the scaffolders in the practices of pole carrying.

Somewhere around this time my father, obviously concerned about where his only son (in fact only child) was going in life, called me in for a 'father and son conversation'. These were not frequent, so I still have fairly good recall of the main content of this conversation. Most significant was him pointing out that while scaffolding paid well now, I would be earning very much the same amount in real

terms in 20 years-time and may not find it such a physically relishing challenge as the years pass by. Also, he pointed out that with my 'O' and 'A' levels I should have plenty of choices. The problem was, I did not know what I wanted, well not in occupational terms anyway. Being an architect, like my earlier framing of being a civil engineering technician, was largely idiosyncratic—just as many small boys wanted to drive a fire-truck in yesteryear.

In response, I went to the local careers office, where I must say, personnel were helpful. I had many interviews, including at accountancy and legal firms, so my options were good. Not sure which way to go, I was eventually introduced into the idea of going to university, something I had no meaningful frame on whatever. I had never met anyone who had gone to university and my only prior knowledge in this area was a weekly TV quiz show *University Challenge* in which different universities competed for some prize or other. It soon became apparent, however, that there were some attractive aspects to going to university, not least government grants, long holiday periods and opportunities to develop my footballing skills. The only missing piece of this jigsaw was that one had to study a subject. Nothing came to mind for me. Motivated to some extent to pursue this option, I browsed through a number of university prospectuses and—hey presto, psychology. In all honesty, I did not know much about psychology but I guessed it was a bit like sociology, which was one of my 'A' level subjects. Sociology was also my favourite school subject, again made interesting by the teacher.

In summary, serendipity rather than any thoughtful sense of direction shaped my learning and career to this point. Studying psychology was a life changing experience in that I discovered that one's learning is very much within one's own control. Invariably, the constraints of finance, time and commitments may reduce the timing of one's career choices, but successful learning is very much in one's hands. However, successful learning involves in no small part knowing what it is that you want to learn and for what life goals. It also requires a strategy, and not least a fair bit of effort, which in turn is aided by a belief system that sees attainment as a product of these processes, not a predestined neurological state. There is a saying in football circles that, "You are only as good as your last game." That makes perfect sense. I have noticed, over many years of watching professional football, how fickle football fans are. When a player has had a few poor games there are often sounds of derision when his name is read out on the team sheet. Three weeks prior, the same player was greeted with great applause. A similar frame plays out in life. I was once a grade 9 'O' level student in maths. I could still have been that; but I am not and I know what changed that reality and how it works. Hopefully, that has made me a better teacher. Poor thinking, limiting beliefs and lack of competence are not existentially fixed states for the mainstream population of learners, but if no change is effected they become stable and *the reality* for the people concerned. Learning is about change, and productive change can be greatly helped by others, but these others need to be good models. For example, in the case of thinking, as Dilts (1980) illustrates:

> Effective thinking strategies can be modelled and utilized by any individual who wishes to do so. (p. 193)

The key point to this heuristic for the purposes of effective teaching and enhancing learner attainment, is that learners require structure in their learning, and this starts with having a meaningful goal. While students are ultimately responsible for their own learning, helping them to frame clear and meaningful goals, as well as what is involved in meeting them, is fundamental to providing structure, direction and motivation to their learning. As Ramsden (1992) pointed out:

> It is indisputable that, from the students' perspective, clear standards and goals are a vitally important element of an effective educational experience. Lack of clarity on these points is almost always associated with negative evaluations, learning difficulties and poor performance. (p. 127)

There is a strong evidence base supporting the importance of establishing clear, meaningful and challenging goals for learners, For example, Marzano et al. (2007) found an effect size of 0.97 for Specifying Goals, and Hattie (2009) found an effect size of 0.56 for Challenging Goals. The more we are able to articulate learning goals, be specific about what is to be learned—make it visible (what it looks like, sounds like and feels like)—the more likely learners are to achieve these outcomes. Of course, it helps even more if the learners themselves are motivated and committed to achieve such outcomes. As Hattie (2009) highlighted:

> …effective teachers set appropriately challenging goals and then structure situations so that students can reach these goals. If teachers can encourage students to share commitment to these challenging goals, and if they provide feedback on how to be successful in learning as one is working to achieve the goals, then goals are more likely to be attained. (p. 165)

Similarly, Schank (2011) reinforces the really important outcome of student buy in:

> Teaching works best when you teach students who agree that they really want to learn whatever it is you have to teach. (p. 43)

There is often a need for creative teaching to facilitate such high level student buy in across divergent student groups, as this involves a major perceptual shift for many students in terms of motivation and learning approaches. However, if this can be attained, the focus can then be largely on the how of learning effectively rather than frequently revisiting the why. What constitutes challenging is of course subjective in part, but most importantly we are seeking the best contextualization to the learner profile. Providing goals that are easy to attain results in little value on the learning stakes. The idea of giving students such goals to ensure they get plenty of positive feedback regarding their successful attainment, to promote their self-esteem, is naïve at best. Students know that they are being 'dumbed down', and will quickly not be duped by such token positive self-regard. Similarly, if the goals are not realistically achievable in terms of student's prior knowledge (e.g., level of conceptual understanding; skill-sets), and in the time frames defined, this will create frustration and stress which is detrimental to learning and attainment. While it is

sometimes challenging for the teacher to establish meaningful and challenging goals for students, it is time well spent, as Hattie (2009) concluded:

> Educating students to have high, challenging, appropriate expectations is among the most powerful influence in enhancing student achievement. (p. 60)

It is very important therefore to be able to, as far as is possible, ascertain their prior learning before setting goals. This is covered in some detail in Core Principle 3: *Learners prior knowledge is activated and connected to new learning*. Once the student profile is ascertained in terms of prior knowledge, always recognizing that there will be variation in almost any student group (and this should be accommodated for whenever possible), there are many ways to represent appropriate goals to learners. What is most important is that students are provided with as clear as possible a definition of what the goal entails, the level of proficiency of the performance activities and products that are required to be produced in meeting the goal, and any other key information that provides essential structure to making it as tangible as possible. This can involve providing examples of what good performance and product outcomes look like, sound like and feel like. For example, when teaching professionals are seeking to attain a goal that involves being able to use specific instructional techniques (e.g., using questions to promote critical thinking in a facilitation session) I will often show different video exemplars of what this looks like in a sample of teaching contexts related to their field of practice, and invite questions for purposes of clarification. A noted effective way of supporting this in the context of a lesson is through the provision of what is referred to as an *advance organizer*, which is a summary of what is to be learned in the coming lesson. This is presented at the beginning of the lesson, providing an organizing frame for the content which is to follow and a means for students to monitor personal learning in meeting the stated objectives related to the overall learning goal. The more these organizers connect to the desired goal the better is the guide for learning. It's a bit like using a road map. A very accurate one can make the journey easy; the converse is also true. Apart from providing clarity and structure to the learning process, advance organizers help students to see purpose in the learning and further reinforce the meaningfulness and motivation of successful goal attainment.

2.1.3 Core Principle 3: Learners Prior Knowledge Is Activated and Connected to New Learning

When I arrived in Singapore in 1995, and took up my appointment at Singapore Polytechnic, I was asked by a colleague, on my first morning at work, if I had been able to access my email. Immediately, a sense of anxiety became apparent as I posed the question to myself, "How do I do this?" I had never used email before or even accessed the internet. The internet was at best a very fuzzy concept in my head. It became no less fuzzy after a few days when I was a participant in a one-day

training programme on using the internet. At the end of the workshop, I was even more confused and could not even recognize or open the internet browser, Netscape. Yes, I started to feel a bit silly, but this was not a concern, as I knew exactly where I was in the learning stakes—a complete novice. In this learning situation, I was very aware of my limited prior knowledge of email and the internet. Furthermore, as a novice, it's natural to experience feelings of uncertainty, even dependency, and performance will be erratic at best. That's the profile of a novice in an unfamiliar learning situation, irrespective of whether one has great expertise in other fields. Aside, I am also very much a novice as a guitar player and on the one occasion I did a public performance, fortunately in a minor venue, even my basic chord playing went out of synchronization. I have never played publicly since.

Looking back on that one-day internet training programme highlights the difficulties faced by any learner who is confronted with a learning situation in which there is little prior knowledge to connect to and where the instruction is far too fast to build any useful understanding of what is being taught. I went back to my office tired, confused, and with no useful understanding or competence to use the internet. However, what I did know was that this was a typical and almost inevitable result given the learning context and most importantly, I knew how to deal with it effectively.

Learners come to any new learning situation (whether it be the classroom or elsewhere) with preconceptions about how the world works based on their life experiences. Within this framing, they may have developed some generalized beliefs about themselves as learners, as outlined earlier in terms of Fixed or Growth mind-sets. They may also have had some experience (which may or may not have been favourable) with a particular subject or area of learning. As described, previously, after my grade 9 maths 'O' level result and the preceding learning experience, I did not feel competent or confident in learning mathematics. The problem is that prior learning may have created a whole host of misconceptions and motivational dispositions that lead people to avoid any further attempts at learning in a particular area. This takes on an added significance in that all learning, whether accurate or otherwise, exists as relatively permanent structures in our neural architecture. I was fortunate in that my final 'O' level maths teacher, Mr. Edrich was able to challenge and disrupt my existing knowledge and beliefs relating to learning mathematics. For many, they become stuck in an abyss of misconceptions and perceived limited capability. The important point is that new learning cannot avoid being connected to prior learning. As Shulman (1991) pointed out:

> All new knowledge gains its form and meaning through its connection with pre-existing knowledge and its influence on the organization and reorganization of prior knowledge. (p. 10)

Prior knowledge then is the lens through which students will perceive and react to new information provided in a learning event. If prior learning is inaccurate, incongruent or limited, it is likely to interfere with the meaningful integration of the new knowledge presented. This provides real challenges for teachers. Ausubel et al. (1978) went as far as arguing that:

> If I had to reduce all of educational psychology to just one principle, I would say this: the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly. (p. 163)

Making student's prior knowledge explicit helps not only to deal with misconceptions and facilitate better linking of new knowledge to existing knowledge structures, but also saves an enormous amount of time in terms of duplicated learning (e.g., Nuthall 2005), boredom for students, as well as frustration for teachers. Finding out what students already know, understand and can do is fundamental to teaching in any context. Hattie (2012) argued that:

> …we must know what students already know, know how they think, and then aim to progress all students towards the success criteria of the lesson. (p. 44)

There is then the challenge of designing ways to connect new knowledge to the particular learners being taught. This requires both a good understanding of the subject matter content and the students being taught, as well as some creativity in order to design the most appropriate instructional strategy to best facilitate such connectivity. Wlodkowski (2008), using the language of cognitive neuroscience, suggests that this involves the following:

> …begin with what they already know and biologically assemble them with the new knowledge or skill by connecting the established networks and the new networks. (p. 13)

This heuristic has an effect size of 0.41 (Hattie 2009) and in combination with clear goals and effective advanced organizers, provides a strong foundation for subsequent learning, and can be seen as significant components of a highly effective "Russian Doll" instructional strategy, to reiterate this metaphor introduced in Chap. 1. Once students have clarity of purpose in the learning goals, a sense of direction for meeting them, appraised their existing knowledge and dealt with any restrictive misconceptions, they are in a much better position to tackle new concepts effectively. Of course this is an ideal scenario and it is unlikely to happen so nicely for all students in all situations. However, it is a much better strategy than going straight into the new content delivery, for all the reasons outlined above.

The activation of students prior knowledge can be done in a number of ways, but all involve eliciting specific feedback concerning what they actually know, understand and can do (and to what level of proficiency) in relation to new learning goals and specific outcomes. This can be done through written and oral pre-tests, and by way of open discussion with students to explore more fully their mental models and ways they are thinking about the topic area to be covered. It is important to recognize that students are unlikely to be particularly clear on things they don't know and may not be able to effectively make this explicit. For this reason it is particularly important to create a psychological climate in which students feel very comfortable in sharing their learning concerns and are not afraid of admitting to 'not knowing'. This is explored in some detail in Core Principle 9: *A psychological climate is created which is both success-orientated and fun*.

2.1.4 Core Principle 4: Content Is Organized Around Key Concepts and Principles that Are Fundamental to Understanding the Structure of a Subject

Understanding is about making personal meaning of knowledge and seeing how it is used in real world applications and problem-solving. When learners have developed a good understanding of a topic, they will have acquired an organized and accurate representation of the key concepts in their minds (often referred to as 'schemata'). Once attained, understanding will facilitate effective and efficient retrieval of the relevant knowledge of the topic from long-term memory, easy explanation of what the topic is about, its key components, areas of contention, as well as its thoughtful application in real world problem-solving. Furthermore, with good understanding of something, whether it's the working of mechanical systems or, in the context of this book, pedagogy, it's then possible to use this knowledge effectively across the domain field, what is referred to as *transfer* of learning. Transfer facilitates accurate diagnosis of problem situations and the capability to create solutions with a high degree of outcome prediction, because it means that the person fully understands the knowledge bases involved. For myself, I have little understanding of mechanical systems; hence I am unable to fix anything mechanical. My Jack Russell dog occasionally sits on the remote control devices that operate the television and related systems, often resulting in picture loss on the television. It typically ends up with me ringing the technical support helpline. I don't know what most of the various buttons on the different remote control devices mean, what aspect of the system behaviour they control, or their relationships to each other. In a situation of picture loss, unless it is patently obvious what has happened (e.g., the on button is now off), my understanding is so limited I am effectively taking part in a lottery where there is a low probability of success; my chances of hitting the appropriate buttons on the relevant remote control devices in the correct sequences are not good.

In the literature much is written about the nature of knowledge, types of knowledge and how knowledge and cognitive processes interact to build understanding by philosophers, educationalists, and cognitive scientists. The study of the nature, form and structure of knowledge is a recognized discipline, typically referred to as epistemology. We will avoid an extensive coverage of this area as much of the different terminology conflates and may, in this context, add more confusion rather than insight into how core concepts and principles help students to understand the key structure of a topic, and what makes this particularly important to learning and attainment. One area of general agreement among writers on the types of knowledge, which provides a useful understanding of what knowledge entails, is the categorization of knowledge into *Declarative Knowledge* and *Procedural Knowledge*, as summarized below:

Declarative Knowledge: As the term implies, it refers to knowledge that can be clearly stated as facts, concepts, generalizations or principles within a content

knowledge field. For example, once acquired, we might be able to clearly assess that a learner *knows* or *understands*:

- the concept of democracy
- the defining attributes of a dog
- the conventions of punctuation
- Cristiano Ronaldo plays football for Real Madrid (at the time of writing)

Procedural Knowledge: This refers to knowing how to do something, typically involving performing a process or demonstrating a skill. For example, once acquired, we might be able to clearly assess that a learner *is able to*:

- add and subtract
- write a paragraph
- juggle
- set up an experiment
- read music
- search a database

In many practical tasks both types of knowledge are involved, as to do something typically involves knowing something about it. For example, while the amount of declarative knowledge involved in being able to play football is not extensive, no amount of skill in procedural terms would be useful if one did not know what goal to score into. Invariably, there is much variation in terms of both the quantity of knowledge components and level of complexity involved in knowledge acquisition and deployment when procedural. For example, to acquire a single piece of factual knowledge such as England won the soccer world cup in 1966 is very straightforward. Around 5 repetitions should put it firmly into long-term memory. How memory works and its crucial role in effective learning is outlined in detail in Core Principle 7: *Learning design takes into account the working of memory systems*. In some exceptional circumstances a little idiosyncratic knowledge may be amazingly useful to a particular individual, as was so powerfully illustrated in the 2008 film 'Slumdog Millionaire'. The film featured a young man (Jamal) from the slums of Mumbai who appears on the Indian version of 'Who wants to be a millionaire?' and answers all the questions correctly, but aroused suspicions that he must have cheated. However, in the film, Jamal recounts in flashback how he knows the answer to each question, each one linked to a key event in his life. His learning of these specific bits of factual knowledge happened idiosyncratically, but through great serendipity resulted in the illusion of him being highly knowledgeable, which ran counter to his slum living existence. In reality, we are very unlikely to get such highly favourable results from limited knowledge bases. The building of accurate organized mental models (deep understanding) of complex phenomena in the world requires much internal cognitive work on the part of the learner to negotiate and assimilate the vast knowledge bases involved. One does not need much knowledge (declarative or procedural) to ascertain why one's pencil is not working and how to fix it. However, this is unlikely to be the case in a situation of aircraft failure, unless of course you happen to be an expert aircraft

engineer. What this cognitive work is and how it works is the focus of Core Principle 5: *Good thinking promotes the building of understanding*.

Understanding is something students can achieve themselves only through the acquisition of relevant knowledge, actively making appropriate connections between the knowledge components (e.g., declarative and procedural) to build an accurate schemata of the intended learning goal. The rote memorization of knowledge, while fundamentally important in effective learning, will not in itself result in understanding as this requires the learner to actively make the mental connections and create accurate internal representations. This involves what we refer to as 'thinking'. However, thinking without knowledge is pretty limited—try thinking about nothing. As Resnick (1989) summarized:

> Study after study shows that people who know more about a topic reason more profoundly about that topic than people who know little about it. (p. 4)

There should be little surprise here, after all, "knowledge is power"—right? It is power to do things that have perceived value, whether at work, or any other area of life. What is deemed the most valued knowledge bases is one of valuation, and this reflects many aspects of stakeholder interest and societal context. However, what is important is the clear recognition that the acquisition, organization and integration of relevant knowledge bases are foundational for better learning and attainment. Berliner's (1987) description of the benefits of comprehensive and well organized schemata (the basis of good understanding) in a particular field or domain is particularly informative in this context:

> Individuals possessing rich, relatively complete schemas about certain phenomena need very little personal experience to learn easily, quickly, and retain well information pertaining to those phenomena. A well-developed schemata allows very efficient learning from verbal and written discourse on a topic about which much is known. (p. 61)

Similarly, as Pugh and Bergin (2006) point out:

> …for students to access and apply their learning they need to possess deep-level, connected knowledge structures. That is, their knowledge needs to be conceptually deep, cohesive, and connected to other key ideas, relevant prior knowledge, multiple representations, and everyday experiences. (p. 148)

There is much we can do as teaching professionals to facilitate understanding. You will note that the three preceding Core Principles of Learning (motivational strategies, clear goals, and activating prior knowledge) all contribute in some significant way to facilitating the process of building understanding. Through a careful analysis of the learning goals, the specific outcomes and proficiency standards that we seek to achieve with our students, it is possible to identify the key declarative and procedural knowledge (especially core concepts and principles) that underpin understanding of the key structure of the topic areas we are teaching. Bruner (1966) identified what are essentially key evidence-based principles underpinning the importance of good structure in enhancing learning:

> The first is that understanding fundamentals makes a subject more comprehensible. (p. 23)
> The second point relates to human memory. Perhaps the most basic thing that can be said about human memory, after a century of extensive research, is that unless detail is placed in a structured pattern, it is rapidly forgotten. (p. 24)

> Third, understanding of fundamental principles and ideas…appears to be the main road to adequate "transfer of training." To understand something as a specific instance of a more general case – which is what understanding of a more fundamental principle of structure means – is to have learned not only a specific thing but also a model for understanding other things like one may encounter. (p. 25)

Bruner advocated a *Spiral Curriculum* in which the key concepts and principles are revisited over time to further clarify and extend the knowledge base in terms of adding new related knowledge, enhancing integration and further refining until the students mental schemata has the most accurate and appropriate mental representation, what he refers to as "the full formal apparatus that goes with them", (p. 13). He is famously noted for asserting that:

> We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any age of development. (p. 33)

For example, in this chapter, *evidence-based practice* and *heuristics*, in the form of the Core Principles of Learning, are some of the key concepts and principles fundamental to the structure of creative teaching. Once these are understood, the more specific factual content relating to how the Core principles of Learning enhance aspects of the learning process will become increasingly easier to accommodate into a meaningful mental schemata. Over time, with thoughtful application, the knowledge base becomes more refined, elaborated and practically useful. In the wider context of this book, as the key structure becomes increasingly understandable in terms of how to enhance the practice of teaching from an evidence based approach, the more abstract notion of 'Pedagogic Literacy' starts to become a meaningful and useful proposition (he says, hopefully). Just as clear and meaningful learning goals and advance organizers provide structure to what is to be learned, this heuristic focuses our attention to the most appropriate selection of knowledge components and their best organizational structuring and sequencing for facilitating the learning experience to maximize attainment opportunities for learners. While the mind has a natural tendency to organize information into meaning wholes, as Gestalt psychology established in the early 20th century (e.g., Koffka 1915; Kohler 1929), this is greatly aided and enhanced when there is a clear and logical structure in the presentation of knowledge in the first place. As Hattie and Yates (2014) pointed out:

> The mind does not relate well to unstructured data. We find it extremely taxing to learn random lists or when coping with unrelated materials. We need to learn the organization, structure, and meaning in whatever we learn. *Meaningfulness*, or relatedness, stems directly from prior knowledge. We benefit enormously from being shown how to group information, how to locate patterns, how to use order, and how to schematise and summarise. (p. 115)

Furthermore, it has long been recognized that different subject areas, by their very nature, lend themselves to different teaching and learning approaches in terms of effective student learning. For example, Shulman (1991) argues that teachers require 'pedagogic content knowledge', which is the ability to fully understand how their particular disciplines are most effectively taught. This involves not only the identification of core concepts and principles essential for building understanding, but also key areas where misconceptions and areas of difficulty are likely to be encountered by students. In this way, the instructional strategy can be systematically tailored to incorporate effective methods that are specifically contextualized to the nature of the discipline and how practitioners in the field actually conduct their practices in real world contexts. The importance of applying not just pedagogical knowledge to the ways we teach but also supplementing this with pedagogical content knowledge is nicely captured by Shulman when he argued:

> When was the last time you saw a problem set in the study of Hamlet? Or in Asian History? Can you have guided practice in a poem? Or for evolutionary theory? I would argue that we have, reflected in the differences among the disciples, different ways of knowing that are tied to different ways of teaching. (p. 5)

This heuristic challenges teachers to know their subjects especially well in order to be able to identify the most appropriate method combinations to effectively teach the key concepts and principles that are fundamental to understanding in the specific context of their subject topic areas. In a similar vein, McTighe and Wiggins (1998) refer to the importance of focusing content on the 'big ideas' and 'essential questions' that are central to making sense of a topic area and its importance within the wider subject context. The big ideas relate to the more fundamental and enduring understandings relating to a topic areas, as they

- Provide a conceptual "lens" for any student
- Provide breadth of meaning by connecting and organizing many facts, concepts and skills; serving as a lynchpin for understanding
- Point to key knowledge at the heart of expert understanding of the subject
- Require "uncoverage" because its meaning or value is rarely obvious to the learner, is counterintuitive or prone to misunderstanding
- Have great transfer value; applying to many other inquiries and issues over time —"horizontally" (across subjects) and "vertically" (through the years in later courses) in the curriculum and out of school. (p. 69)

Big ideas provide an excellent vehicle for helping students to understand both the key structure of a topic area as well as its relevance to real life contexts. As the authors argue, they provide:

> …a conceptual tool for sharpening thinking, connecting discrepant pieces of knowledge, and equipping learners for transferable applications. (p. 70)

Essential questions are core to the subject and will stimulate thought, provoke inquiry, and spark more questions relating to the essential core structure of the topic area, further enhancing understanding. As the authors summarized:

> The best questions point to and highlight the big ideas. They serve as doorways through which learners explore the key concepts, themes, theories, issues, and problems that reside within the content, perhaps as yet unseen: it is through the process of actively "interrogating" the content through provocative questions that students deepen their understanding. (p. 106)

McTighe and Wiggins argue that a question is 'essential' if it is able to:

1. Cause genuine and relevant inquiry into the big ideas and core content
2. Provoke deep thought, lively discussion, new understandings and more questions
3. Require learners to consider alternatives, weigh evidence, support ideas, etc.
4. Help makes connections with prior learning and personal experiences
5. Naturally recur, creating opportunities for transfer to other situations and subjects.

Furthermore, as knowledge is increasing almost exponentially, and it is not possible to keep adding more and more subject content in the curriculum, the selection of the most relevant content knowledge for developing key understandings fundamental to the structure of topic areas becomes an essential pedagogic consideration. Willingham (2009) cleverly framed this *essential question* in terms of, "What knowledge yields the greatest cognitive benefit" (p. 36). In more laymen's terms, as the maxim goes, "More is not better, better is better" and this applies particularly well to the selection of subject content in preparing to teach. Equally, research (e.g., Hattie and Yates 2014, p. 7) strongly suggests that we will invest effort more strongly when we have already built some useful foundation of knowledge (e.g., understanding), in contrast to when there is nothing to build on. Being able to quickly help students achieve a basic understanding of what a topic entails and its relevance to their learning goals not only helps the cognitive aspects of the learning process, but also the affective domain of emotions and feelings in that this is more likely to generate and maintain a better motivational base for a more sustained learning experience. This explains why we are often reluctant to take on tasks in which we feel we have very little understanding or competence and perceive a big gap between where we are and where we need to be in the learning stakes. Sadly, this often results in a person giving up in an area of learning that he/she had initial interest in pursuing. I nearly did this with maths, but was fortunate to have a good teacher 'to pull me out of the pit'—so to speak, which made the difference.

2.1.5 Core Principle 5: Good Thinking Promotes the Building of Understanding

In Chap. 1, I mentioned that thinking was not something I learned from my 15,000 h at school. Well my teachers can be easily forgiven, if Wagner's (2010) conclusion is correct:

> In schools, critical thinking has long been a buzz phrase. Educators pay lip service to its importance, but few can tell me what they mean by the phrase or how they teach and test it… (p. 16)

> For the most part, teachers haven't been trained to teach students how to think. (xxiv)

There is often an assumption that thinking is simply common sense. Well, even if it is, and I don't think it is, it's not that common. In most basic terms thinking is goal directed cognitive activity, which seems to occur not just at a conscious level (e.g., "I must think this through"), but also subconsciously and unconsciously. The outcome of good thinking is typically a heightened, or at least improved, understanding of something. Certainly, thinking is essential to building understanding as it involves the making of connections in the brain, and this is learning at the neural level. In most basic terms, as Willingham (2009) summarized:

> Thinking occurs when you combine information (from the environment and long-term memory) in new ways…That combining happens in working memory. (p. 11)

He goes on to argue:

> …learning to think clearly and knowing how to assess the value of new evidence that one has found, must be the main goal of any school system. (p. 110)

There is, despite differences in perspective and terminology in the literature, strong agreement that thinking is crucial to the quality of human learning. As Paul (1993) summarized:

> Thought is the key to knowledge. Knowledge is discovered by thinking, analyzed by thinking, organized by thinking, transformed by thinking, assessed by thinking, and, most importantly, acquired by thinking. (vii)

Petty (2009) puts this into a very practical context when he argued that:

> It is no exaggeration to say that almost every aspect of private and public life is driven by our ability (or inability) to use these thinking skills effectively, and to 'think straight'. (p. 325)

However, while good thinking may be beneficial in the learning stakes, there are those who do not see the human mind as particularly well developed for such activity, as Willingham (2009) concluded:

> Humans don't think very often because our brains are designed not for thought but for the avoidance of thought. (p. 4)

Hattie and Yates (2014) offer the following analysis:

> The ability to think well, to learn efficiently, and solve problems successfully are attributes that do not figure in most descriptions of natural human adroitness. While a few of us seem to want to develop good thinking skills (however defined) – it does not seem to be typical – …humans naturally assimilate the vast bulk of their knowledge through direct social influence processes that do not make great demands on thinking capabilities. (p. 7)

There is indeed an interesting paradox as far as thinking is concerned. On the one hand, as Jensen (1996) argued:

> The best thing we can do, from the point of view of the brain, is to teach our learners how to think. (p. 163)

On the other hand, the human brain for a significant proportion of the population does not seem to want to do this too willingly. Kahneman (2012) provides a powerful insight here, which has extensive implications in educational contexts and how we teach. He argues that thinking can be conceptualized in terms of two systems; System 1 and System 2. These are, of course, metaphors, but they convey something that instantly has strong face validity:

System 1 is a fast reflexive system that identifies the familiar, especially threatening elements in a situation and quickly activates automatic response patterns. This system is the most essential for survival and is the default system. It typically works well in familiar everyday life where most situations and problems are familiar and we have long established patterned responses to them. However, this system also results in rapid stereotypical/prejudicial judgements and action. It is the price we pay for this powerful survival system.

System 2 is a slow, analytic, reflective system that explores the more objective factual elements of a situation, compares them with previously learned elements, and then responds. However, this requires self-control, effort and time, which is essentially tiring. As Kahneman summarizes:

> System 1 is impulsive and intuitive; System 2 is capable of reasoning, and it is cautious, but at least for some people it is also lazy. (p. 48)

The development of good thinking, then, has much in terms of similarity with other desirable outcomes sought by people. For example, few people actually enjoy going on a diet or working long hours of overtime. However, there is benefit to weight loss when obese and extra money is very useful and often essential for some. The same can be said for developing good thinking, as far as effective learning is concerned. We clearly recognize the longer term benefits, but the shorter term cognitive strain is often likely to short cut our perseverance to do this well in many situations.

If good thinking is hampered by it being a tiring activity and some of us have 'lazy' brains, this is further compounded by the impact of beliefs and emotions on our capability for rational cognitive activity. Marcus (2009), from a cognitive neuroscience perspective, highlights how our belief systems further provide challenges to the brains functioning as a good 'thinking machine':

> Our beliefs are contaminated by the tricks of memory, by emotion, and by the vagaries of a perceptual system that really ought to be fully separate – not to mention a logic and inference system that is as yet, in the early twenty-first century, far from fully hatched. (p. 67)

Similarly, Pinker's (2002) description of how the mind works illustrates why rational thought is far from a natural activity for humans:

> Behaviour…comes from an internal struggle among mental modules with differing agendas and goals. (p. 40)

Csikszentmihalyi (1990) goes as far as to argue that, "Contrary to what we tend to assume, the normal state of the mind is chaos" (p. 119).

It is therefore not that surprising that good thinking is more than just *common sense*, or we may need to accept that common sense is a much rarer capability than is typically assumed. However, despite the many barriers to good thinking, it can be effectively modelled, understood, and improved. As Perkins et al. (1995) pointed out, "People can learn to think and act intelligently" (p. 18). However, there is little point in asking students to engage in good thinking if they have no accurate and useful prior knowledge of what this means. In the absence of useful knowledge in this area, as for any area of new learning, a whole host of misconceptions are likely to come into play, and we know what this eventually leads to—a confused and frustrated learner.

There are many models of thinking in the literature (e.g., Marzano et al. 1988; Swartz and Parks 1994; Perkins 1985) and the keen reader can find much of interest. Having spent many years researching this elusive human quality, I have evolved a model of thinking (Sale 2014) based on extensive modelling of how professionals, across a wide range of fields, actually solve problems in their working contexts. It must be recognized at the outset that accurate conceptualization of internal cognitive processes is inherently problematic and invariably unreliable, especially across subject domains. However, without some valid practical frame on what these elusive but desirable skills are, and how they work in terms of the wider context of internal mental activity, there is little chance of the effective teaching and assessment of them. As Schank (2011) pointed out:

> The real issue is how learning actually takes place in the mind. (p. 3)

The task of framing what constitutes good thinking, how this works as an internal process, and what other factors influence its application in real world problem solving is a challenging one. However, research suggests that while there is variation in how humans experience phenomena in the world—based on prior experience, belief systems and selective perception, etc., our common human apparatus and need orientation typically results in shared ways of experiencing the world. As Marton (1981) summarized:

> …we have repeatedly found that phenomena, aspects of reality, are experienced (or conceptualized) in a relatively limited number of qualitatively different ways. (p. 181)

What this means, for example, is that while psychologists may solve problems is some qualitatively differently ways from engineers, both at the individual and collective level, there is much of similarity in the types of cognitive activity involved. For example, they will need to analyse situations (cases), make comparison and contrast with similar cases, build up inferences and interpretations from ongoing perceptions and data accumulation, generate possible solutions and decide action based on chosen criteria. Around this swirl of cognitive activity, there will be an overall monitoring of what is going on, typically referred to as metacognition. The summary model is depicted in Fig. 2.3: Sale Model of Types of Thinking, and the typical cognitive heuristics involved are outlined in Table 2.1: Cognitive

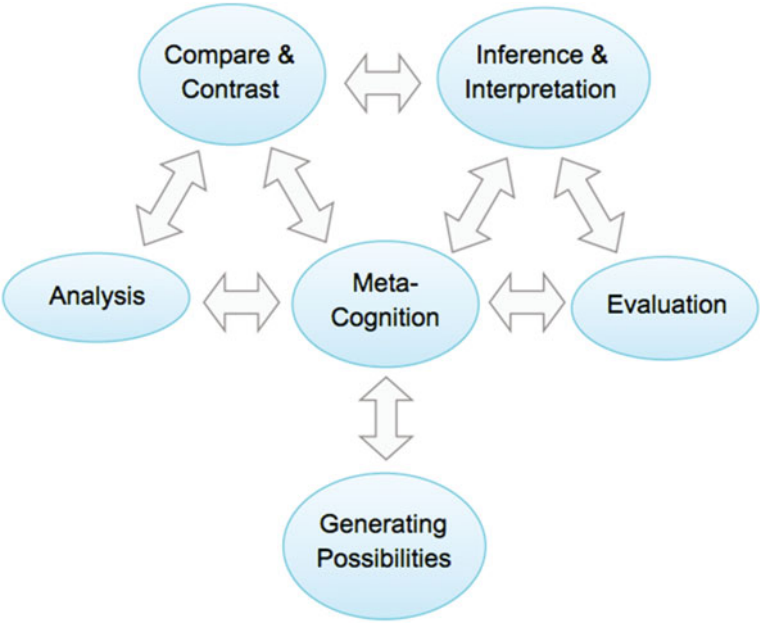

Fig. 2.3 Sale model of types of thinking

Heuristics of Types of Thinking. Note that the cognitive heuristics for each type of thinking are the essential framing questions that have to be negotiated in making sense of information and building understanding.

In this model, analysis, compare and contrast, inference and interpretation and evaluation are typically employed during critical thinking; whereas generating possibilities, as the term implies, is predominantly employed in creative thinking. Metacognition refers to the awareness of and ability to monitor and control one's cognitive and affective processes in order to enhance thinking and learning. This executive function seems unique to humans, and makes self-reflection and self-regulation possible. What this means, at the practical level, is that individuals who have developed a strong metacognitive capability are able to be much more focused and systematic in their approach to learning, indeed life, than those lacking in this area. They are able to run a quality assurance check on what they know, don't know, need to find out, as well as ensure that they are employing the necessary specific types of thinking to ensure that understanding of what they need to learn is being attained. Similarly, they are able to be more conscious of how their own belief systems, emotional and personality dispositions may be affecting their learning and performance, whether this is for the good or otherwise. Persons with strong metacognitive capabilities are more able, as compared to persons less competent in this area, to specifically identify and apply the most effective learning-to-learn strategies and skills to support their learning goals, as well as manage

Table 2.1 Cognitive heuristics of types of thinking

Generating possibilities
• Generate many possibilities
• Generate different types of possibilities
• Generate novel possibilities
Compare and contrast
• Identify what is similar between things (e.g., objects/options/ideas)
• Identify what is different between things
• Identify and consider what is important about both the similarities and differences
• Identify a range of situations when the different features are applicable
Analysis
• Identify relationship of the parts to a whole in system/structure/model
• Identify functions of each part
• Identify consequences to the whole, if a part was missing or malfunctioning
• Identify what collections of parts form important sub-systems of the whole
• Identify if and how certain parts have a synergistic effect (for open systems)
Inference and Interpretation
• Identify intentions and assumptions in data
• Separate fact from opinion in data
• Identify key points, connections, and contradictions in data
• Make meaning of the data/information available
• Establish a best picture to make predictions
Evaluation
• Decide on what is to be evaluated
• Identify appropriate criteria from which evaluation can be made
• Prioritize the importance of the criteria
• Apply the criteria and make decision
Meta-Cognition
• Recognize the ability and usefulness of thinking in an organized manner
• Actively think about the ways in which we are thinking
• Monitor and evaluate how effective we are thinking
• Identify and manage beliefs and emotions which may hinder the quality of thinking
• Identify and utilize strategies to improve the quality of thinking

aspects of self that are less congruent with goal attainment. For example, extroverts tend to become bored more easily than introverts, and as a result may find adhering to an organized and sustained study programme quite difficult. However, by being consciously aware of this and its potentially negative consequences (e.g., not passing an high stakes exam; forgetting an important work deadline) such persons can create, monitor and evaluate a personal motivational and self-management strategy to mitigate the chances of likely failure. It is to be noted that while metacognitive capabilities have a high effect size of 0.69 (Hattie 2009) which is

hardly surprising, they are inevitably subject to the same principles of cognitive strain and inherent laziness documented by Kahneman earlier. For example, on many occasions, students have asked me what they need to do in order to attain high grades. I typically respond with a comment such as, "Know what you need to know, know it, and know that you know it." In fact, this is pretty much on the button, and it's far from rocket science. However, to get to this state of competence, there are a few things that need to be done that many people don't particularly like. Yes, one is good thinking, and another is hard work and persistence in doing something that may not be that pleasurable. Rohn's (2014) reflections are poignant in this context:

> Average people look for ways of getting away with it; successful people look for ways of getting on with it.
>
> Success lies in the opposite direction of the normal pull.

Good metacognitive capability is the basis of students becoming self-regulated learners and this represents a key educational aim. Once learners have developed such capabilities, they have the foundational base for more autonomous or independent learning, as well as possessing the essential understanding and necessary skills to be increasingly effective as lifelong learners. Effective metacognitive activity on the part of the learner will typically involve:

- Ensuring that clarity of learning in terms of goals is achieved
- Being able to estimate what can be learned in given timescales, based on what needs to be learned and what is already known
- Planning a successful learning strategy (e.g., what, how, when, where)
- Knowing what strategies help to achieve what aspects of the learning process (e.g., retention of facts, understanding, skill development)
- Reviewing and evaluating one's progress and making appropriate changes in strategy when necessary (this is an iterative process).

In practice, these types of thinking run as overlapping and intertwined programmes, moving from foreground to background as the focus of framing a problem changes and new questions emerge. Certainly, when creativity is sought, generating possibilities is at the mind's forefront, but other types of thinking will weave in and out of consciousness and, typically run continuously in the subconscious mind. However, the good thinker will periodically take a conscious metacognitive view and attempt to make sense of (understand) what is actually going on in his/her mind, check various aspects of cognitive and affective processes (e.g., the types of thinking; impact of beliefs and emotions) and make adjustments when necessary. Good thinking then is the ability to navigate this 'perpetual cognitive and affective swirl', and to be able to employ the various heuristics of these types of thinking in a fluid, efficient and highly synergistic manner. This is perhaps the reason that good thinking is quite rare in many situations, and why we really need to teach it to our students.

It is in this context that some writers in the field see good thinking not just in terms of cognitive processes and heuristics but also in terms of the development of intellectual traits and standards. For example, Paul et al. (2006) identify the following traits as central to acquiring a high level of expertise in critical thinking:

- Intellectual humility—sensitivity to one's own biases and the limitations of knowing
- Intellectual courage—prepared to question own beliefs and those of others, even if unpopular with dominant perspectives and people
- Intellectual empathy—awareness of the need to actively entertain different views from one's own
- Intellectual integrity—holding oneself to the same intellectual standards of others (no double standards)
- Intellectual perseverance—working through intellectual complexities despite frustration
- Confidence in reason—recognizing that humankind's interests are best served by giving free play to reason
- Intellectual autonomy—thinking for oneself in relation to standards of rationality and not uncritically accepting the judgements of others
- Fair-mindedness—conscious of the need to treat all viewpoints alike and not be influenced by vested interests.

Such dispositions are certainly desirable, but the extent to which some are more integral to deep seated personality traits is open to question, as well as is our capability to facilitate their successful development in formal educational contexts. However, they represent desired values and dispositions for learning and, as teaching professionals, we do our best to facilitate such outcomes, albeit being a difficult task.

This is one of the most challenging heuristics to apply successfully for all the reasons identified above, and it may explain in no small part Wagner's conclusion at the onset of this section. Teaching thinking is indeed challenging, but it is without a doubt necessary. In a world of increasing complexity, global volatility, almost unlimited (but questionably useful) information genres and sources, good thinking is now most needed. We are being incredibly naive if we assume that effective thinking and self-regulation will naturally occur for most students, simply by encouraging or telling them to do so. Without sufficient foundational knowledge and skill in good thinking, as well as an understanding on how emotions, beliefs and other vagaries of the human mind influence such capability, many will lack the necessary understanding and competence to self-regulate effectively. As Hattie and Yates (2014) summarized:

> There is skill in knowing when to think, what to attend to, and when to stop thinking to save cognitive resources. We need to know when to think fast and when to think slowly. (xvii)

In helping students to develop the full range of thinking skills (i.e. metacognitive, critical and creative thinking) it is firstly essential to be very clear about what these entail, as summarized previously in Fig. 2.3 and Table 2.1. This enables the

framing of clear learning goals and specific outcomes that cue the different types of thinking. For example, in a unit or module on Environmental Science where a key learning goal is that students develop a key understanding of how to Manage Pollution, some specific learning outcomes could include:

- Analyse the causes of the main types of pollution
- Compare and contrast different types of pollution in a range of contexts
- Make inferences and interpretations concerning the effects of pollution in different situations
- Evaluate the effectiveness of existing pollution policies
- Generate possible ways for reducing pollutants in a range of contexts.

Having framed the learning goals and key outcomes, other Core Principles of Learning are to be applied in designing the overall instructional strategy. For example, it would be particularly important to activate students prior knowledge relating to how they are presently thinking, in order to ascertain and make visible their present knowledge components, misconceptions, and significant gaps in understanding. As Ritchhart et al. (2011) spelled out:

> We need to make thinking visible because it provides us with the information we as teachers need to plan opportunities that will take students' learning to the next level and enable continued engagement with the ideas being explored.
>
> It is only when we understand what our students are thinking, feeling, and attending to that we can use that knowledge to further engage and support them in the process of understanding. Thus making students' thinking visible becomes an ongoing component of effective teaching. (p. 27)

In order for students to be able to fill in significant knowledge gaps, clear up existing misconceptions and kick start a process towards better understanding in this important area, it is necessary to introduce a structured teaching approach that facilitates this important part of the learning process. This can be done in a variety of ways, but most effectively through Whole Class Interactive Teaching (Hattie 2009). This is far from a one-way transmission or 'teacher talk' approach to teaching, but a structured learning process involving a range of active learning methods (e.g., advance organizers, question and answer, tailored application activities and, of course, plenty of ongoing feedback). In this process, it's really important to ensure that good thinking is clearly and explicitly modelled through a range of relevant examples to the subject topic. As Sheppard et al. (2009) recognized:

> …teachers have to make their own intellectual processes (their performances) visible. This means that the teacher-expert has to make visible to learners the otherwise invisible processes of thinking that underlie complex cognitive operations …
>
> Teachers have to articulate and demonstrate rather than assume the thought processes they want students to learn. (p. 188)

In the process of helping students to build sufficient understanding of what constitutes good thinking and how to develop this capability, some key instructional strategies are particularly useful. For example, making thinking visible (both

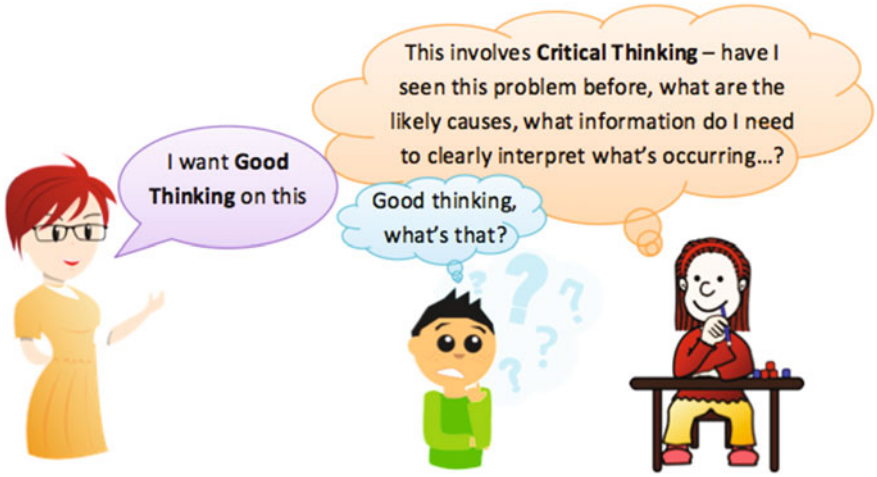

Fig. 2.4 Mental models of thinking

student thinking and teacher thinking) is essential, but this must be done consistently and sufficiently for it to become cemented in long term memory and established as an everyday practice when good thinking is required. In order to facilitate this effectively, the key terminology relating to the various heuristics of the types of thinking need to become part of the language of learning (to consolidate a language of thinking). For example, I often hear teachers, who I assume are seeking to encourage student thinking, use terms like "What are your comments on this" or "Lets discuss this"—even "I want good thinking on this". Taking the latter example first, this assumes that students actually have a mental model (schemata) of what constitutes thinking. However, in reality this may vary widely (e.g., Fig. 2.4 Mental Models of Thinking). If they have no prior useful mental model, then they are either totally blank or in the process of just commenting, which typically results in statements like, "Its ok", or "I don't like it much", which has little underpinning thoughtful analytical or evaluative base to it. In contrast, when students understand the different types of thinking, and the cognitive heuristics involved, they can respond thoughtfully (no pun intended) to their teacher's systematic use of language to specifically cue these types of thinking. This provides the essential modelling and practice to develop competence over time. For example, a possible teacher question in a situation of comparing two solutions to a problem situation might be something like, "Comment on these two proposed solutions". However, to provide the essential structuring to cue and develop the desired thinking process, a better questioning approach would involve something along the lines of, "Let's compare and contrast these two solutions…identify what is similar and different in each… what is significant about the differences in the solutions…what's important about these differences …how do these differences impact the problem situation we are trying to address, etc.?".

Fig. 2.5 Draft performance task incorporating types of thinking

Through the use of appropriate cuing questions, in which the types of thinking are naturally infused into the content of the topic, students will quickly become familiar with the 'language of thinking'. For example, when asked to evaluate options, whatever the subject context, they will have already internalized that this requires the deriving of relevant criteria to be used in evaluation, the likely prioritizing of these criteria in terms of relative importance in making the decision, and finally to apply the criteria, based on the available information, to the option or range of options. To further build understanding and actual application or competence, it is essential to provide appropriate practice through specific performance-based learning tasks that incorporate the types of thinking to be developed. As Wasserman (1993) clearly identified:

> Central to a pedagogy that seeks to promote the development of good thinking is the systematic use of well-constructed and managed learning tasks that reflect real world activity and involve the use of specific types of thinking. (p. 20)

A draft learning task that incorporates the key types of thinking is summarized in Fig. 2.5: Draft Performance Task Incorporating Types of Thinking. The more detailed process of activity design to infuse types of thinking and other process skills with content knowledge and skills is outlined in Chap. 4.

The explicit teaching of what metacognition involves and the range of metacognitive strategies that are useful in supporting the learning process is particularly important. The same evidence-based approach is necessary, utilizing relevant Core Principles of Learning as appropriate to the situated context. Again, activating prior knowledge is the initial starting point. Invariably the term metacognition is unlikely to be familiar for many students. In this situation it is necessary to make them aware of this distinctive human capability and demonstrate clearly from personal experience and other examples how metacognition works and what makes it so important to learning, attainment and personal success. A useful strategy is to ask students to think about what they have done in the past which they may now have some regrets about (there is no need for them to recall this publicly, for obvious reasons), but to model in their own minds the situation, their thinking and the

actions taken at the time, and the consequences they experienced. They are then asked what they have learned since that experience and how they now, in retrospect, look at it differently and may now choose to respond with a different strategy. This activity makes students very aware that they can actually think about their thinking, and identify different ways of looking at things in their world (i.e. reframing).

Also, when students are involved in a sustained learning activity (e.g., project work) structured metacognitive practice can be periodically included where they are required to appraise the quality of their thinking and the learning strategies they are using to deal with the challenges being encountered. Once students understand the range of learning benefits (e.g., better planning, monitoring and evaluation of learning) from heightening metacognitive capability, a range of other related learning-to-learn strategies and skills can then by systematically infused into specific learning activities over time. In this way students can build their competence and confidence as independent and self-directive learners, which is a very desirable long-term educational outcome. Metacognition should also be facilitated through other 'Teachable Moments'. In this context, these are situations in which students may have not been doing the necessary metacognitive work and there is clearly a need for it in the present learning situation (e.g., students have hit a block in their learning; it is apparent that their thinking has become disjointed or fuzzy).

2.1.6 Core Principle 6: Instructional Methods and Presentation Mediums Engage the Range of Human Senses

> Against boredom even gods struggle in vain.
>
> (Friedrich Nietzsche 2014)

In Core Principle 1, the notion of motivation being driven by pleasure, pain avoidance and novelty was introduced. Pleasure and pain avoidance are very obvious in terms of their motivational origins and impact, but how does novelty work and what is its significance in terms of the design and practices of teaching? When I first arrived in Singapore, I took an instant liking for a local delicacy, 'chilli crab'—you must try it if you come to Singapore. In fact I had this, and other local dishes, almost every night. Indeed, on one occasion, I remember an elderly Chinese lady at the local hawker centre (that's a Singaporean term for food court) saying to me, "Why you always have chilli crab, lah, why not spring roll?"—or something similar to that. Well, the answer at that point in time was easy, "I like chilli crab." However, one night, and it was inevitable in retrospect, the chilli crab was served up in its typical form, but my response was not the usual positive one. Suddenly, its appeal seemed to have vanished completely. The chilli crab was no different, but my perception had somehow changed and with this my whole orientation to it was

different. Invariably, based on my East London values, I ate it; after all it's not right to leave good food—a punishable offence by parents in my younger years, if caught. In psychological terms, I was becoming *habituated* to chilli crab and its appeal had greatly diminished. I had become bored with it. Sadly, as humans, we have an inherent tendency for this to happen, even for things and people we really like. I have not eaten chilli crab in many years. When teachers ask me what is the best teaching method, I tend to recite a variant of the chilli crab story as an advance organizer. Yes, some methods are more effective than others, but the overuse of any one method inevitably results in habituation and students will get bored. I can recall academic faculty at a previous educational institution attending a workshop on Project-based Learning. Many came back excited and wanting to use it in their teaching. Well, imagine the students on a Monday morning, when for the first time they get to choose aspects of their learning and be more actively involved in the learning process, it's a novelty. However, by Friday afternoon, when they have amassed several projects, the enthusiasm for such pedagogy has long receded. Too much of the same thing gets boring, and as Willingham (2009) concluded, "Change grabs attention, as you no doubt know" (p. 17). This is often why we go on holiday —even though it often ends up stressful, especially when taking young children who keep saying, "I wish we could go home". If the Gods struggle in vain, what chance for us mere mortals with this existential nemesis?

Hence, in terms of learning and teaching, the creation of appropriate variation in the modes and mediums of delivery, which stimulate the range of senses, is highly significant for enhancing the learning experience for students. Mental activity is stimulated through our five senses, with the visual sense probably the most dominant. The relative dominance of our vision system may well be the result of our evolution, as Mlodinow (2012) captures so interestingly:

> …an animal that sees better eats better and avoids danger better, and hence lives longer. As a result, evolution has arranged it so that about a third of your brain is devoted to processing vision… (p. 35)

In many situations the greater the combination of our senses that are appropriately stimulated in a planned learning event, the more potentially effective the experience is likely to be in terms of gaining better attention and facilitating the desired learning outcomes. For example, it is estimated that when we see and hear something, this doubles the sensory impact as compared to just hearing it. Direct experience will increase the impact further and, teaching it, will enhance it further still. This should not be surprising as the act of teaching, if conducted properly, will involve much by way of preparation. Most specifically, it will involve developing a strong understanding of the key content areas, especially those concepts and principles that are fundamental to understanding the key structure of the topic area. It will also involve identifying areas of potential difficulty and where the main misconceptions are likely to be experienced by learners. Finally, there will a systematic structuring and sequencing of how best to present this content in the most effective and efficient method combination. In my experience, by actually assessing how well someone has learned takes this process even further. When assessing

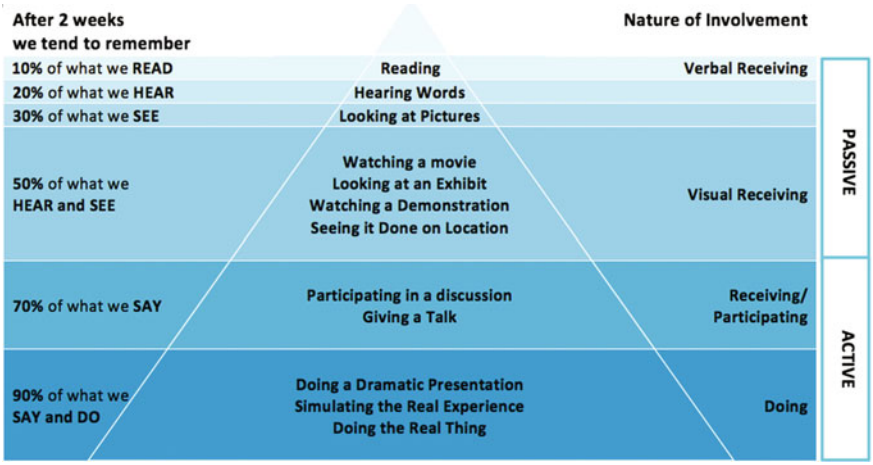

Fig. 2.6 Edgar Dales' 'cone of learning'

students, one must firstly be able to validly ascertain whether or not and to what extent the key learning components (e.g., the desired learning outcomes) have been met in the performance evidence to ensure accurate judgement of performance. In making assessment decisions, especially of a summative nature (e.g., when one is making a final assessment decision or ascribing a grade), the assessor is claiming to know learners in some fundamental way that often has significant impact on their access to future educational channels and employment opportunities. Secondly, as assessment (formative) is a key aspect of the learning processes, this requires assessors to accurately diagnose students' specific areas of weakness and then provide tailored feedback to help them strategize effective future learning strategies. The area of assessment and the importance of feedback are addressed in some detail in Core Principle 10: *Assessment practices are integrated into the learning design to promote desired learning outcomes and provide quality feedback.*

Edgar Dales' famous 'Cone of Learning' (Fig. 2.6: Edgar Dales 'Cone of Learning') is often shown to illustrate how different senses and activities affect the learning process. The percentages have a limited empirical base and are quite arbitrary; however it provides a generalized illustration on how different combinations of sensory input may affect the type and quality of learning.

The use of audio-visual aids is common practice in seeking to enhance student learning through different sensory modalities, and it is certainly the case that the human mind responds positively to multi-media (Hattie and Yates 2014). The cinema, of course, exploits this to its fullest impact. Our brain is set up well to integrate information from different source inputs, especially from different modalities. Strong learning occurs when words and images are combined, and these effects become especially strong when the words and images are made meaningful through accessing prior knowledge. Good visual representations work because:

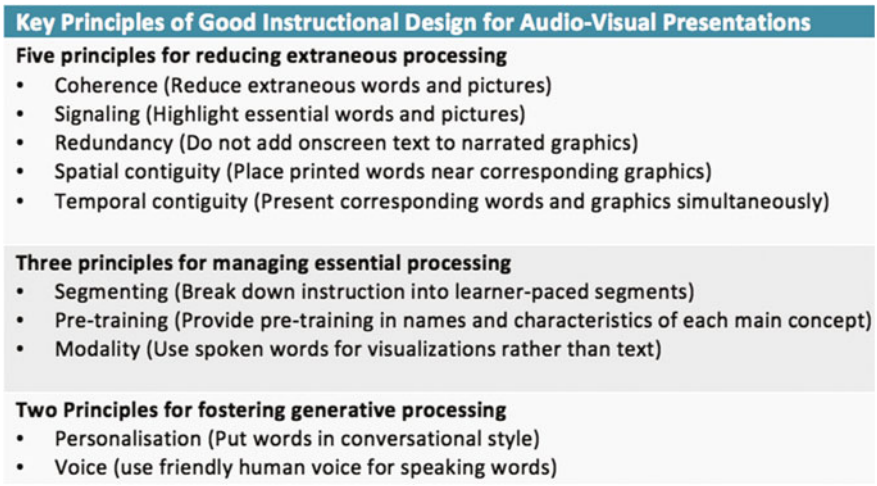

Fig. 2.7 Key principles of good instructional design for audio-visual presentations

- Recall is almost always visually triggered; hence visual representation acts as a cue triggering the full memory
- Only structured information can go into Long Term Memory, so this helps the transmission from Working Memory into Long Term Memory and subsequent recall
- They facilitate the ability of learners to see the relationship of a whole to its various parts, which fosters understanding.

However, it is important not to over use audio-visual aids or to create too much variation in modes and mediums of presentation. I have seen many teachers using audio visual aids and varied presentation formats, all with good intentions to enhance the learning experience, but only to create confusion for students. There is now much evidence-based research on how best to present visual material to facilitate effective learning. For example, Mayer and Alexander (2011) summarized a number of key principles that specifically impact the effectiveness of multi-media on learning (see Fig. 2.7: Key Principles of Good Instructional Design for Audio-Visual Presentations).

As Mayer makes clear:

> These practical implications are examples of *evidence-based practice* – basing instructional methods on research evidence rather than on conventional wisdom, opinion, speculation, fads, or doctrine. (p. 441)

This heuristic is not difficult to understand in terms of how it can enhance student attention and attainment as it has strong face validity. For example, we have all both experienced boredom and how it affects our attention and disrupts learning, as well as being stimulated by high impact multi-media movies. I remember being amazed by the film 'Avatar' because of the multi-media effects, even though the

story had some ridiculous concepts such as helicopter gunships, resembling what are used today, on a planet in another solar system many light years away—really? However, today's multi-media and internet rich resource pool is a double edged sword. On the one hand, it offers the creative teacher much in the way of capability for building networks of integrated resources, differentiating the learning experience and creating instructional strategies that provide better attainment opportunities for an increasingly wider cohort of learners. On the other hand, we must bear in mind that today's learners, so familiar with the internet and its diverse entertainment and communication options, will not simply give attention to 'bells and whistles' multi-media. The ability to design creative content and effective instructional strategies may be even more necessary today than in yesteryear.

2.1.7 *Core Principle 7: Learning Design Takes into Account the Working of Memory Systems*

Human memory is a little bit like having a Maserati sports car, but only being allowed to use the first gear, except on special occasions. A Maserati will hit a top speed of 185 miles per hour, but certainly not in first gear. Our memory has two main systems, long-term memory (LTM) and working memory (WM). These are depicted in Fig. 2.8: Summary of Memory Systems. Our LTM seems to have unlimited storage capability. It's not that our brain gets bigger as we learn more; rather it becomes denser in terms of neural connectedness, though we can never live long enough to actually test its full capability. However, before information can be stored in LTM, it must firstly pass through WM, which has very limited immediate capability when processing new information. The 'magic' 7 (able to process around 7 plus or minus 2 bits of information at one go) was originally documented by Miller (1956), for what was then referred to as short term memory. However, more

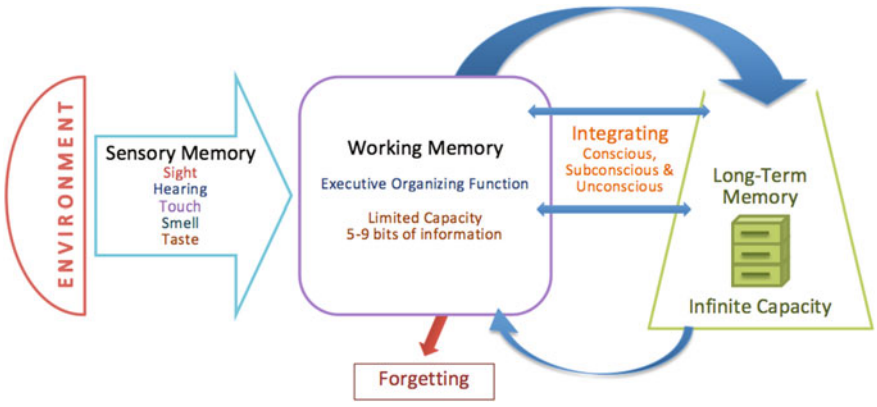

Fig. 2.8 Summary of memory systems

recent research (Van Merrienboer and Sweller 2005) suggests that in everyday situational use, this tends to be only 2–4 elements at a time. WM also needs quick rehearsal for information to be effectively captured and processed otherwise it is typically lost (forgotten) after only a few seconds. The limited capacity of working memory poses problems for learning, as Clark and Lyons (2005) point out:

> …it is in working memory that active mental work, including learning, takes place. Working memory is the site of conscious thought and processing. (p. 48)

Similarly, Ormrod (2011) summarizes the importance of this key memory system:

> Working memory is the component of our memory system in which we hold attended-to information for a short time while we try to make sense of it. More generally, it's where our thinking occurs. For example, working memory is where we think about the content of a lecture, try to decipher a confusing textbook passage, or solve a problem. Whatever our consciousness is, this is probably where it is housed. (p. 55)

You may also remember from Core Principle 5 that the human mind is, for many of us, inherently lazy in that System 2 thinking typically is draining on our cognitive resources and results in what is often referred to as 'ego-depletion' (Kahneman 2012). Quite simply, excessive cognitive activity, like excessive physical activity, is not the norm for most people—one must choose to develop these capabilities. It is also the case that, at a conscious processing level, the brain is relatively slow as a processing system, especially when compared to computer technology. If you have any doubt, do this simple exercise:

> How many capital letters in the English alphabet are curved?

If you already know the answer, it would be immediate; otherwise it would probably have taken you some 25–30 s to get the correct answer (11). However, type in Jack Russell terrier on your PC and you will get 4,250,000 hits (Well, at 1.50 pm, Singapore time, June 1, 2014). Given the limitations of WM, a largely lazy thinking system and slow processing speed, we start to get a somewhat limiting picture of human learning capability. Hattie and Yates (2014) make the point which many of us don't want to face up to, when they highlighted:

> Notions such as instant experts, superfast learning, speed reading, and other magic-like programs, amount to faddish quackery in violation of known and validated principles of human learning. If only it was that simple. (p. 113)

However, the picture is not as bleak as it seems, as there are ways in which we can use our memory akin to driving the Maserati in 4th gear. This becomes possible, even easy, once we have acquired vast knowledge, understanding and expertise in a particular field. Such capability is fully encoded as highly integrated neural networks (e.g., cognitive schemata) in LTM. WM has no limitations when dealing with such information retrieved from LTM, as it dramatically alters the functionality of what is taking place within the memory systems. The two systems effectively merge into one fluent dynamic entity working towards meeting the conscious goal of desired information retrieval and solving the problem in hand.

Furthermore, over time this process becomes increasingly automated, and as Hattie and Yates (2014) summarized:

> When your knowledge becomes so automatic that you can access it quickly, with virtually no effort, then the WM system is said to be bypassed through the automaticity stage – a most desirable place to be. (p. 147)

This enhanced memory capability explains why a person very fluent in a language can always find the words they want to use and assemble them in complex sentences instantaneously. Contrast this with the novice trying to learn the days of the week in a new language. It took me more than an hour to learn (as in encode sufficiently in LTM for later effective retrieval) the days of the week in Mandarin, and that was quite good.

It has been popular in educational circles to downplay the importance of rote learning and memorization. After all we want flexible adaptive and creative thinkers today—right? Yes, but such high level human capability is largely based on what we have acquired in our LTM system. Basically, if there is not much information in there, and it's not particularly well organized and connected, there is little chance of creative or even useful outcomes. This could not have been levelled at the neural arrangements of Einstein or Da Vinci, and it may have been a definitive factor in their *genius* capabilities. It is not surprising that Kirschner et al. (2006) concluded that:

> …long term memory is now viewed as the central dominant structure of human cognition. Everything we see, hear and think about is critically dependent on and influenced by our long-term memory. (pp. 3–4)

Research clearly shows that a major factor that differentiates experts from novices is that expert problem-solvers are able to draw on the vast knowledge bases in their LTM and quickly select the best approach and procedures for solving a given problem. As Kirschner et al. further argued:

> We are skillful in an area because our long-term memory contains huge amounts of information concerning that area. That information permits us to quickly recognize the characteristics of a situation and indicates to us, often unconsciously, what to do and how to do it. (p. 4)

This essentially means that the more you have effectively learned and appropriately organized in LTM, makes subsequent learning in that area or field more effective. As Willingham (2009) noted:

> …having factual knowledge in long term memory makes it easier to acquire still more factual knowledge. (p. 34)

> One of the main factors that contributes to successful thought is the amount and quality of information in long term memory. (p. 17)

This goes very much against the prevalent view among many educationalists that we should not be encouraging rote learning, but instead focusing on building understanding through the development of thinking. As documented earlier, understanding is important and the development of good thinking is essential to

achieving this. However, this is a bit like having a Maserati, knowing how to drive it, but not having any petrol to put in the tank. Csikszentmihalyi (1990) was correct in arguing that, "It is a mistake to assume that creativity and rote learning are incompatible" (p. 123). Memory and thinking are equally important in the development of understanding, share interdependent functionality in the learning stakes and there may be little point in viewing them as distinctly different processes. It is the construction of elaborate mental schemas in LTM that provides the conscious mind, operating in working memory, with room to think when solving problems. Repetition and review are vehicles enabling knowledge to be stored in reliable retrievable units which, over time, accelerate mental growth through conceptual mastery and deeper understanding. As Willingham argued (2009):

> As far as anybody knows, the only way to develop mental facility is to repeat the target process again again again. (p. 87)

There is an elegant simplicity here; mastery of knowledge bases, good neural interconnectedness and plenty of varied retrievals of such knowledge, actually reduces the need to activate slow deliberate thinking processes—System 2 thinking. Hence, when solving known problems, the solutions are readily retrievable as memory algorithms or at least solid heuristics from LTM. That's the beauty of top level expertise, and why persons possessing such capability typically get paid so much more than mainstream professional folk. I like the story about the expert chemical engineer who was called into a plant emergency where the on-site engineers could not identify why a reactor was not starting up, and where losses could run into many thousands of dollars a day if not rectified. The expert engineer walked around the plant, looked at various part of the system, made certain adjustments to various parameters in the units, and within a couple of hours had the reactor working as it should. Later she billed the company $20,000. The company, not challenging the cost, given the alternative scenario, did ask the consultant engineer for a breakdown of the bill. The reply went something like this, "$1000 for the call out, $19,000 for what's in my head".

This heuristic has many implications for how we teach. Perhaps most apparent is the need to chunk up information into manageable learning structures to prevent cognitive overload on WM. This must take careful account of the prior learning of our students, as its level of integration, completeness and ease of access for retrieval will impact very significantly on our pace and focus when teaching. For example, when students are presented with new information and have very limited prior knowledge or a number of misconceptions in that area, they will be particularly vulnerable to cognitive overload in WM. In this situation they will struggle to process it meaningfully, feel confused, and fail to assimilate it meaningfully in LTM. Cognitive load (and overload) has been distinguished into two main, interrelated, components: intrinsic cognitive load and extraneous cognitive load (e.g., Van Merrienboer and Sweller 2005). Essentially intrinsic cognitive load is related to the task complexity itself and the ability of WM to deal with it. For the novice, a complex learning task will create cognitive overload, simply trying to make sense of it. Extraneous cognitive load refers to introducing information into the learning

situation that is not relevant to the learning (e.g., unnecessary text, graphic or colour change) or being poorly organized. This can be significantly reduced by good instruction design. As the authors emphasize, "There is no substitute for evidence-based instructional design" (p. 173). In contrast to the novice learner, when teaching students who have a high level of knowledge and expertise in an area, we can present information much quicker and in more elaborated forms, as they already have highly developed mental schemata in that knowledge field. In terms of analogy, this is why I can read (and usually make good sense of) several psychology journal papers in a day, but cannot retrieve the television picture when my dog sits on the remote control device and scrambles the channels.

Students need time to rehearse new information in their minds and consolidate it appropriately into existing mental schematas, which is facilitated through application activities that generate appropriate types of thinking (e.g., analysis, compare and contrast, inference and interpretation and evaluation), as this facilitates understanding. The wise teacher will provide this structure for students, and adjusts the pace of instruction accordingly. Consolidation of learned material in LTM is further reinforced through providing systematic reviews stimulating the retrieval of key information from LTM and bringing it to conscious attention in WM (Fig. 2.9: Retention of Information With and Without Reviews). Students, and the teacher, can then do a quality check on what has been learned, remediate lost elements, clarify overall understanding, as well as reinforce desired learning. This very act of conscious retrieval from LTM to WM fires related neural structures, which result in the secretion of myelin, an enzyme-based substance that forms an insulating sheath around the axon in a neuron. In basic terms, this further strengthens the learning

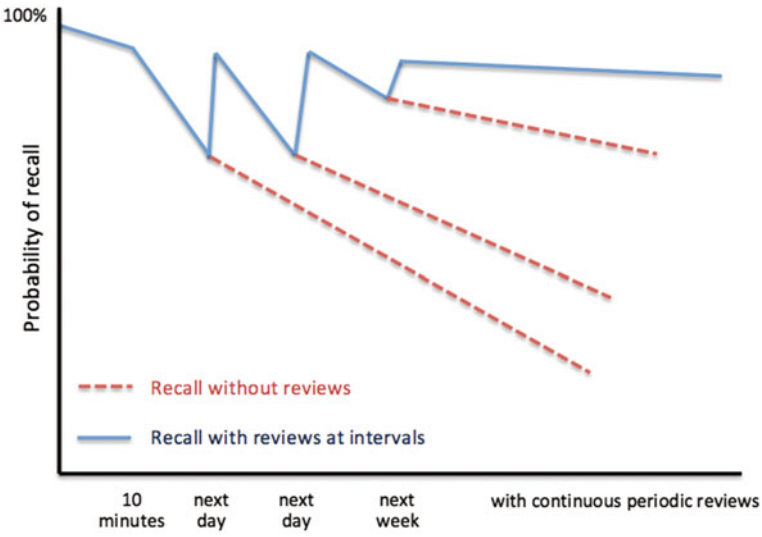

Fig. 2.9 Retention of information with and without reviews

bond in LTM. Talking to oneself, when memorizing for an exam, as long as it is about the 'right stuff', is far from madness, it is a good learning strategy.

Another aspect of how memory systems work, which has important implications for the design of learning and teaching practices, concerns the way in which information is selected and organized when presented to learners. It is well documented that apart from the limited capability of WM to deal with incoming information, the attentional and information processing of it is not uniform. The Serial Position Curve (Murdock 1962) demonstrated that when presented with a list of 16 items to memorize, people typically memorize more at the beginning and at the end, tending to forget what was in the middle. These information acquisition biases have been labelled the Primacy Effect (the tendency for the first items presented in a series to be remembered more easily as compared to most other items) and the Recency Effect (the tendency for the most recently presented items to be remembered more easily as compared to most other items). Another important effect is what is referred to as the von Restorff Effect (the tendency to remember distinct or novel items more easily as compared to most other items), named after the psychologist von Restorff (1933) who discovered it (see Fig. 2.10: Serial Position Curve, incorporating the von Restorff Effect). Even a quick break in a session can represent a change in the stimulus situation and has benefits in attentional and memory processing—"A change is as good as a rest"; another of those old folk sayings that has acquired validity from cognitive neuroscience. Hence, from a practical teaching point of view, the early part of the lesson is where a key impact can be made, both in terms of teaching the main concepts and building rapport. The best motivational speakers know this well, and exploit it to the limit. Similarly, the end of the lesson is also important as it facilitates retention of the key points in summary, as well as linkages

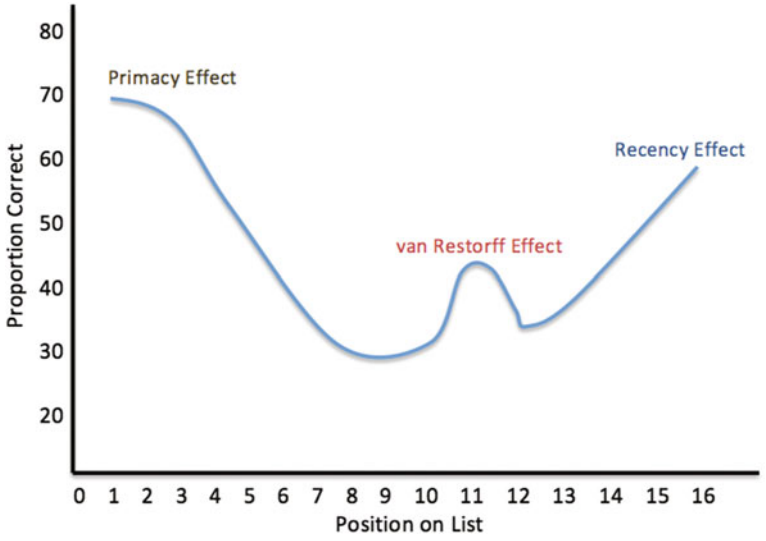

Fig. 2.10 Serial position curve, incorporating the von Restorff effect

with other resources and possibly a short advance organizer for the following lesson. Also, irrespective of what has happened in the lesson prior (e.g., students did not do particularly well on a test), it can be used to finish on an upbeat and positive note, lifting the psychological state of the students. This is similar to ending an interview with a firm handshake and positive eye contact. As we will explore in Chap. 4, specific non-verbal behaviours can also be very influential in influencing the perception and subsequent behaviour of others, albeit largely unconsciously. Finally, in this context, the creative teacher, through well designed changes in method and activity, can trick the brain into paying much more attention than it would customarily give over a given time duration. A creative application of a von Restorff Effect, will put the 'icing on the cake', metaphorically speaking.

Many teachers have long recognized the importance of presenting information in manageable chunks and then structuring activities that give students time to make sense (digesting) of it through discussion or other forms of application. Over time they do periodic recap and review to increase the chances of effective transfer and retention in LTM, as well as remediate gaps in learning. We are developing a more precise science that underpins how this works and can now confidently predict that when utilized thoughtfully in practice, there is likely to be significant gains in student attainment. We can all remember the teachers who bored us. There are a number of behaviours that can contribute to boredom in the classroom; many are violations of memory processing. Teachers who consistently use practices that conflict with the working of human memory will experience frustration with the gaps in many students' learning. The frustration and consequences will invariably be greater for the students themselves.

2.1.8 Core Principle 8: The Development of Expertise Requires Deliberate Practice

Most Saturday mornings I have an interesting experience. I usually go into the gym at my apartment block in Singapore and do around 30 min of high intensity weight training. It's not difficult to explain my behaviour in terms of Bentham's pleasure and pain reduction parameters. The gym work helps keep my weight, blood pressure and cholesterol levels down—definitely pain reducers. Also, I am able to continue getting into my existing wardrobe of clothes and, whatever people might say to the contrary, you generally get treated better if you look better, which I would rate as pleasurable and novel at my age.

Let's get back to the real significance of the gym story. Whilst doing my weight training programme, I occasionally look out of the window at the people playing tennis. I have noted that several players never seem to get any better even after a few years, playing the same novice game every week. They are unable to serve, do not adopt proper body positions when striking the ball and don't even seem to focus attention on the ball when they hit it, and I'm not a professional tennis coach.

The notion that learning inevitably improves over time and that experience is central to such improvement is not founded. Yes, time on task is important and so is experience. However, it is more about what is done when on task that really makes the big difference in the experience. For example, why is it that some people, who have many years of experience, still display limited competence, whereas relative newcomers achieve good competence in a comparatively short time? The conclusion of Berliner (1987) offers insight into such questions:

> …experience will probably only instruct those who have the motivation to excel in what they do and the metacognitive skills to learn from their experience…we believe that individuals with that kind of motivation to learn and in possession of a set of strategies for learning from experience are literally transformed by their experience. (p. 61)

It is certainly the case that motivation is a key factor in effective learning. However, it's also about being clear about learning goals and having the strategies and resources to achieve them. Furthermore, in skill development, one must put in a lot of actual *doing*, and much of this is what is typically called practice. Of course we know practice is important. I like the quote from the legendary golfer Gary Player (1962), who once said, "The more I practice, the luckier I get." However, we are increasingly aware that it is not just practice per se, but how the practice is organized and the way feedback is utilized. Colvin (2008) noted that exceptional performers were not necessarily the most talented in terms of their earlier biographies, but had certain attributes and practices that distinguished their expertise over time. Of most importance was what is now referred to as *Deliberate Practice*. According to Colvin, Deliberate Practice is characterized by a number of key elements:

- The activity (practice) is carefully designed to improve specific aspects of the performance, often with a teacher's help
- It requires much repetition
- Feedback on results is continually available
- It is highly demanding mentally (whether a physical or mental task)
- It isn't much fun (in the main; but may be for some).

It is important that there are clear and realistic improvement targets for the particular learner. This involves stretching the individual beyond an existing performance level to a recognizably improved level in some aspect, but a level that is achievable with effort and coaching from a teacher. As outlined in Core Principle 2, it is important to have as much clarity—visibility—of the learning goal, objectives and proficiency level as possible. In this way motivation is maintained as the learner will have a perceived experience of a higher mastery in at least some aspect of the performance, which further reinforces belief and sustains effort in continuing this learning strategy. To reiterate the point, "Nothing breeds success like success." It is often noted in professional sport that when a player finally wins that elusive major tournament, more seem to quickly follow. Andy Murray winning the men's tennis tournament at the Olympics, the US open, and then Wimbledon, is perhaps an

illustrative recent example. Prior to that, he had failed to win a major tournament, losing in 4 finals.

Of key importance is the role played by expert teachers in helping the learner identify what specific aspects of the performance to improve, structure the practice programme accordingly and provide ongoing quality feedback to maintain focus on the skill development. Again, to use the Andy Murray example, the appointment of Ivan Lendl in this role may have been more than coincidental in his attainment of two major titles within one year. Lendl himself had gone through the experience of losing his first 4 finals in major tournaments but eventually went on to win 8 singles titles in such events. Certainly he had learned something important and this may have helped in coaching Andy Murray. It seems that even the very best in the world still desire and need an expert teacher. It is necessary to emphasize that while deliberate practice is fundamental to effective and efficient learning, it is not a short cut to expertise or even competence (however defined), as Colvin noted:

> If the activities that lead to greatness were easy and fun, then everybody would do them, and they would not distinguish the best from the rest. (p. 72)

What is particularly interesting is that in the process of developing expertise, not only is there an enhancement in understanding and skill, but significant changes in neurology and sensory acuity relating to the field of expertise. Many years of intensive deliberate practice changes the body and the brain, enabling great performers to perceive more, to know more and to remember more than most people. Colvin particularly noted the following key attributes of great performers:

> They all possess large, highly developed, intricate mental models of their domains. (p. 122)

> …observe themselves closely… monitor what is happening in their own minds, and ask how it's going. Researchers call this metacognition …top performers do this more systematically than others do; it's an established part of their routine. (p. 118)

This enables them to:

- add and make sense of new knowledge more quickly and in more qualitatively useful ways
- distinguish relevant information from irrelevant information
- predict what will happen next in a domain specific situation.

Perhaps, what is most significant is the relative ease in terms of cognitive load and strain that they have to expand in doing most tasks in their field. As Kahneman (2012) explained:

> As you become skilled in a task, its demands for energy diminishes. Studies of the brain have shown that the pattern of activity associated with an action changes as skill increases, with fewer brain regions involved. (p. 35)

Expertise then enables a better understanding of a situation, and facilitates heightened perception of what is most relevant for the task at hand. This enables the expert to do many things quickly and automatically, releasing time to be more

situationally responsive and potentially creative. In the context of teaching, Turner-Bisset (2001) identified such capabilities in expert teachers:

> Expert teachers are able to read and process the complex mass of information which any classroom provides, much more rapidly and meaningfully.
>
> …expert teachers use a repetoire of strategies, selecting the most appropriate for use in a particular context and adapting it if necessary for a group of learners. (p. 69)

Hattie (2012) from extensive research supports this heightened capability of expert teachers as well as providing insight into how they are likely to be more creative:

> Experts possess knowledge that is more integrated, in that they combine the introduction of new subject knowledge with students' prior knowledge; they can relate current lesson content to other subjects in the curriculum; and make lessons uniquely their own by changing, combining, and adding to the lessons according to their students' needs and their own teaching goals. (p. 28)

This heuristic focuses attention on the important role of deliberate practice in skill development and attainment. From an evidence-based perspective, we are now able to be much more precise and specific in terms of what types of practice and how best to structure and manage practice to enhance attainment. The saying that "Practice makes perfect" is not quite right, though well intended. Simply getting students to practice and spend more time on task may have limited value in optimizing attainment without the systematic structuring of the practice activity, calibrated to the learner's proficiency level, and with expert feedback. Practice on its own may simply lead to consistent proficiency at *not* doing an activity well, as Berliner noted above, and I observe from the gym window. It is *deliberate practice* that over time is most likely to lead to higher proficiency levels and eventually expertise. However, deliberate practice is very much intertwined with the building of dense and well integrated mental schemata in LTM and the ability to use metacognitive capabilities at heightened levels. As emphasized earlier, each Core Principle of Learning, while focusing on a specific aspect of the learning process, is ultimately part of a dynamic and synergistic system in which specific areas of learning capability become mutually supporting in enhancing human attainment.

In applying this Core Principle of Learning in practical teaching it is important to ensure that the process of using deliberate practice is adhered to as best as is practically feasible. Invariably, in working with large classes it is harder to be as precise in diagnosis, task structuring and giving the time for ongoing feedback, as in the case of purely individualized coaching. However, by making the process of deliberate practice visible and meaningful to students, it is possible with some thoughtful application of collaborative learning and peer coaching—creative teaching—provide better opportunities for enhancing learning and attainment in this area.

2.1.9 Core Principle 9: A Psychological Climate Is Created Which Is Both Success-Orientated and Fun

In Visible Learning (Hattie 2009), the importance of the climate of the classroom was noted as among the more critical factors in promoting learning, with teacher-student relationships, the major determiner of such climates, with an effect size of 0.73.

We are all very clear on what constitutes a physical climate, and its various features. It was a typical everyday conversation in England, especially when in a lift with a stranger. How many times have I heard the comment, "Looks like rain shortly". One of my reasons for leaving the UK was quite simply the climate. I did not like the long winter months, which seemed to last the most part of the year. I prefer the perpetual summer weather in Singapore, and what an easy job weather forecasting is here: "26–33 °C with some chance of rain in the afternoon" is a 90 % correct call on most days. In the UK, as I remember it some 20 years back, weather forecasting was a combination of thoughtful roulette and serendipity, at best.

Now defining a psychological climate is a bit like defining thinking, as we can't actually see, touch or smell it. However, when it is very good or very bad, we can certainly *feel* it. People typically use terms like, "The atmosphere is terrible in there", or "Everything's cool here." Essentially, it's about the nature and types of interactions that are going on—or not going on—between people in a given social and geographical context (in educational contexts it's typically a classroom) and their impact on perception, feeling and subsequent behaviour. The ability to create and facilitate a positive psychological climate in a range of informal interpersonal situations is a great skill set to have. If you have such capability, it's likely that you will always be high on the invite list for socially orientated parties, as you have the skill of creating lively conversational content which helps folk to relax and feel comfortable. Classrooms are no different from most social interaction situations in that there are human actors (teachers and students) involved in interpersonal communication over time for a purpose (e.g., teaching and learning), and some kind of psychological climate will inevitably result. Furthermore, there is no doubt that certain types of psychological climates are much more conducive to learning and attainment than others, which may have adverse effects. Research suggests that a number of key factors are very important for promoting a positive psychological climate. First and foremost, as Hattie and Yates (2014) summarized, this entails the teacher exhibiting attributes that:

> …promote positive and open human communication. Students value being treated with (a) fairness, (b) dignity, and (c) individual respect. These threefold aspects have emerged strongly in all studies in which students are interviewed and surveyed as to what they expect of their teachers. (p. 26)

Similarly, Ornstein and Behar (1995), from research, concluded that:

> . …the most effective teachers endow their students with a "you can do it" attitude, with good feelings about themselves, which are indirectly and eventually related to cognitive achievement. (p. 86)

Very much in the context of this Core Principle, Jensen (1996) found that:

> Learners in positive, joyful environments are likely to experience better learning, memory and feelings of self-esteem. (p. 98)

However the really important questions concern what are the specific things that teachers can do, and how best to do these, in order to create and sustain a psychological climate that results in the students perceiving and feeling that they are being treated with 'fairness', 'dignity' 'individual respect', developing a 'you can do it attitude' and experiencing some sense of joy in participating in the classroom learning activities?

It is easy, though somewhat limited, to address these questions in terms of intent or generalizations. For example, we might say, "Show respect", "Be enthusiastic in how you teach" or "Display passion about learning". This is in many ways similar to going on a first date and having little idea on what to say or do, and being told by a friend to "Be interesting". Such statements are, in both of the above contexts, valid and will make sense to both the cognitive neuroscientist and the layperson alike—but there is something significantly missing. It is interestingly and annoyingly (for me anyway) captured in the saying "Everything is easy when you can do it." Being interesting certainly was not the case for me on my first ever proper date with a girl as a 17 year old. Getting ready to meet Geraldine (that was her real name—it will give her a chuckle if she ever reads this book) at a local cinema on a Saturday night, I suddenly posed myself the essential question, "What do I talk to her about?" Instantaneously, I became anxious, which quickly escalated to panic (we have all been there, and we know what this does for good thinking and confidence). In delving into my LTM system it was not long before I realized that all I ever talked about was football, boxing and fishing with my friends who were all boys. I had no idea at all on what to talk to a girl about, a real lack of prior knowledge containing, in retrospect, mainly misconceptions. The inevitable happened and the date was a disaster. I had nothing to say, was visibly uncomfortable all night, and this clearly contributed to her feeling equally uncomfortable. At the end of the film, the encounter quickly ended with a statement from me like, "How do you get home?" I had a reply something like, "I get the bus from over there." Geraldine never contacted me again, and that's not too difficult to explain. That was my first date and my last for a while; I was afraid to go through that again. If there was an 'O' level in conversational literacy with females, another grade 9 was an absolute certainty for yours truly, at that time. My Jack Russell dog would have fared better, and you will know why shortly.

At university, in the first year of my psychology undergraduate programme, I learned something really useful from a fellow student. I noted that he had an attractive girlfriend and he wasn't Chris Hemsworth. I once asked him about this, a kind of "How do you do this?" type of question. His reply was initially strange, "You need a nice looking friendly dog and walk around the local park." This made no sense to me, until he explained further, "If you do this, girls will notice the dog and want to pet it." I was still no clearer at the time, but you will have probably worked this out by now. As my fellow classmate pointed out you talk about the

dog, mention that you are going for a coffee and would she like to come and have a drink with you. It's just then a matter of generating mutually interesting content for conversation. You might be ready to ask, "How do you do this?", and that was my immediate question to him. Summarizing his response in more technical terms, which all seems so easy now, it's about generating content that the other person is interested in talking about, then showing that you are interested in the responses made (whatever this entails), which is done initially by asking the person what is of interest to him or her. Invariably, as we know, highly impactful interpersonal communication is not just about the verbal content, but also (and probably more importantly) the tone and pitch of voice and the accompanying body language components (e.g., posture, eye contact, gestures). Furthermore these all need to be appropriately calibrated to create *the total communication experience*. However, when one is confident, and this typically comes from one's own self-efficacy and perceived mastery, the communication package comes nicely into place and flows. We should not be surprised as this is simply the result of good learning for these skill-sets. Good understanding plus deliberate practice over time will get one to this desirable state. The converse is equally true. In most basic terms, to be effective at something, having intent is only an initial motivator, you must know how to do it well, and be able to do it at the behavioural level. Ultimately perception and judgements about other people, accurate or otherwise, is the product of their behaviour, and of course, our pre-existing beliefs. Molden (2001) makes the summative point most explicitly:

> It is our behaviour that directly connects to results, even though our thinking may be responsible for generating the behaviour. (p. 59)

In a number of teaching situations, I have seen novice teachers tremble at the front of a classroom, even run out in fear and despair when faced with challenging students or sometimes from forgetting the details of their teaching plan. Quite simply they don't know what to do next and lack the strategies in their long-term memories that might be effective. In contrast, highly competent and creative professionals when confronted with a challenging group of students or even noticing boredom developing on some of the students faces, while never complacent, can typically and smoothly change the teaching strategy in situ (re-create the pedagogy situationally). In most cases, such action results in regaining attention, settling the group down and changing the psychological climate to one that is more positive and task focused. To a novice teacher or outsider this may seem almost like magic, as creativity in any domain often feels a bit like that. However, as for most things (including magic), once they are made explicit at the behavioural and cognitive levels, it all seems rather obvious and logical.

Of course, understanding is not competence, deliberate practice is needed in skill acquisition, but it certainly helps if one knows very clearly what is involved in the learning process. What I have been describing may seem somewhat behaviouristic and contrived, and that is partly true. However, customer service professionals don't learn how to speak, smile and use their voice in certain specific ways just to

fill up training hours on their staff development plans. As Mlodinow (2012) summarized:

> The gestures we make, the position in which hold our bodies, the expressions we wear on our faces, and the nonverbal qualities of our speech, all contribute to how others see us. (p. 110)

He goes as far as to argue that:

> The pitch, timbre, volume of your voice, the speed with which you speak, and even the ways you *modulate* pitch and volume, are highly influential factors in how convincing you are, and how people judge your state of mind and your character. (p. 132)

It's therefore not surprising that politicians and other high profile media people employ communication specialists and psychologists to create certain positive appearances to influence the public at large. They do this because it works in large part with many people, and there is an underlying set of reasons why it works. For many years, I mentored and coached 'underperforming' teachers. These were academic faculty who received below 3.25 on a rating scale (where a score of 5 was 'very good' and a score of 1 was 'very poor') from student feedback for 2 semesters on the formal end of semester online questionnaire. Over the years this highlighted how, in a communication encounter, the relationship between a communicator's intention and the perception and meaning by others can be so incongruent. Many of these teachers also had very negative qualitative comments relating to such things as "shows little interest", "no care and concern" etc. In conversation with them, some were very disturbed by such student responses, and could not explain on what basis and how they might have been perceived in such negative light. They seemed unaware that such perceptions originate from specific behavioural aspects of person presentation.

Essentially, the psychological climate is largely shaped based on how the teacher actually behaves on an everyday basis with the student group. Hattie and Yates (2014) summary of what specific behaviours are positive in this respect are noteworthy, but quite obvious when made explicit:

> The key aspects, as described by a significant body of research involve the teacher's positive open gestures when dealing with the class, physically moving around the room, relaxed body orientation, frequent use of smiles, direct eye contact, and using a variety of friendly and encouraging vocal tones, especially when dealing with an individual student. (p. 28)

They go on to point out:

> The human brain is hard wired to instantly apprehend emotional states in other people …while some cultural differences are found …The notion that humans everywhere share a common basis in being able to recognize emotions in others embodies considerable truth. (p. 266)

Mlodinow (2012, p. 118) quotes research by Ekmann and Friesen (1971) who showed people in an isolated Neolithic culture in New Guinea pictures of American faces displaying a range of typical emotions. These primitive people had never been exposed to outside cultures, used no written language, were still using stone implements, and very few had seen a photograph let alone television or films.

However, when they were shown American faces of basic emotions, they were as able, as people from the 21 literature countries who participated in the research, at recognizing happiness, fear, anger, disgust, sadness and surprise in the faces of the emoting Americans.

Certainly, from my experience of facilitating many workshops in a wide range of cultural contexts, I would also make the case for there being much similarity in terms of people's perception and comprehension of what constitutes good human conduct, a positive psychological climate, as well as the way they learn. Several years ago, I was attending a conference in which one of the keynote speakers was emphasizing how people from different cultures learned very differently, and that we should be thinking of culturally relative pedagogies. In listening, I was reflecting on my own experiences and feeling a bit confused and somewhat annoyed. Yes, of course there are cultural differences, and pedagogy must take into account relevant culturally determined situated factors for a number of obvious reasons. However, in large part, the main specific cultural factors relate more to specific social norms and custom, rather than pedagogic or fundamental interpersonal communication practices. For example, I am mindful of touch, even handshakes in certain cultural contexts, as well as the humour I use. I also notice that in different cultural and ethnic contexts, one must modify the level of informality accordingly. For example, I tend to be more informal quicker in the Philippines than other countries, as participants seem to respond well to this. In certain countries I tend to retain formality longer as I feel that the early display of humour may be detrimental to a perception of high professional credibility. However, my experience is that, irrespective of cultural context, learners will become more informal and appreciate some humour, once they feel comfortable and perceive high credibility in terms of what is on offer in the learning stakes. Culture has impact here, but it may be less than personality configurations. In terms of how people learn, I find little difference, and that's because we share the same brain structure and we learn structurally in the same way. In most basic terms, learners must acquire knowledge through memory processing, make meaning of it (build understanding) through thinking, and acquire skill by doing. In this context there is motivation and beliefs that will come into play, but the essential principles of human conduct and learning seem largely universal, based on my experience. I am convinced that highly competent and creative teachers will be positively impactful anywhere, not with everyone all the time—that's impossible. Equally, very poor teachers will be similarly experienced in negative ways, wherever, in most cases. What is often of noticeable difference is how learners across cultures and contexts actually respond to the variety of teachers they experience. The best are generally always appreciated. However, how the worse teachers fair may vary significantly depending on cultural contexts. In some cultures, it seems that few learners will disrupt or react negatively even in the face of poor teaching, as there is a deep respect for the profession of teaching. They probably remain just internally bored or upset, depending on whether or not the

teacher is just incompetent technically or socially, or both. The latter is a sorry state to experience. In summary, Sale and Mukerji (2006) were delighted to report:

> …in our experiences of co-facilitation over several years, we were initially surprised but ultimately delighted to find that there appears to be a number of generic principles and practices that facilitate rapport and effective learning irrespective of cultural and ethnic contexts. (abstract)

Fun or humour was certainly not a significant feature of my school experience, well not in classroom time. It seemed that learning was a very serious business and anything resembling a joke was a prelude to classroom disruption. As a Cockney from East London, I have always felt that humour was one of the most important aspects of human experience, and this is now supported through a wide range of research (e.g., Garner 2006; Lei et al. 2010). Most significantly, the world famous psychologist, de Bono (2003), frequently refers to humour as "…by far the most significant activity of the human brain" (p. 12). Humour for de Bono is very much related to creativity as it involves the disruption of the brains natural tendency to self-organize on the basis of already existing neural pathways, which will typically restrict truly creative thinking or *Lateral Thinking* in his terminology. As he points out:

> Humour not only indicates the nature of the system but also shows how perceptions set up in one way can suddenly be reconfigured in another way. This is the essence of creativity. (p. 12)

Humour makes us feel better, and this has a positive effect on our psychological state. Of course, humour must be used thoughtfully and in context. However, far from limiting the learning experience, humour is now seen to have a wide range of positive impacts on aspects of the learning process, such as:

- Refreshing the brain
- Creating mental images that retain learning
- Reinforcing desired behaviour and making classroom management easier
- Developing positive attitudes
- Promoting creativity
- Contributing to the enjoyment of teaching

Furthermore, humour seems to have a role in learning more generally. Earlywine (2010) summarized:

> Funny instructors get higher ratings perhaps because humour affects immediacy – the sense that an instructor is present and attentive with students…
>
> …a full semester of instruction that includes relevant jokes that illustrate key concepts lead to better scores in final exams. (p. 138)

The use of humour in terms of creatively enhancing the learning experience and student attainment will be explored in detail in Chap. 4.

This Core Principle of Learning has much similarity with Core Principle 1: *Motivational strategies are incorporated into the design of learning experiences*, as

it applies across all aspects of teaching. The nature of the teacher's interactions with students will largely shape the psychological climate of the classroom, and as Rogers (1983) described:

> …the facilitation of significant learning rests upon certain attitudinal qualities that exist in the personal relationship between the facilitator and the learner. (p. 121)

Many of the important components that underpin the shaping of this relationship have been outlined and illustrated in this chapter and some key areas will be developed further in subsequent chapters. Most significantly as a teacher, shaping the psychological climate is in large part your responsibility, and it can be challenging in many situations. However, as Hattie and Yates (2014) argued:

> As their teacher you are an inevitable coach in interpersonal mannerisms. Hence a deep understanding of how these social processes operate will prove of inherent value in your professional work. (p. 269)

2.1.10 Core Principle 10: Assessment Practices Are Integrated into the Learning Design to Promote Desired Learning Outcomes and Provide Quality Feedback

At school I don't recall the word 'assessment' being used, and certainly not 'learning outcomes' or 'feedback'. We had to sit end of year exams and we were given homework each week, which was marked by teachers. On receiving homework back, we got a graded mark often with a '+' or '−' sign next to it, and a short comment such as, "fairly good", "could do better", etc. I also never recall giving this much thought in terms of what I might have done well and what I had not done well, and certainly not what I needed to do in order to improve and how. It was done and out of the way and that was that. I attach no blame to the teachers as that was assessment practice in those times and context. Assessment was largely seen in terms of summative grading and not as a key facilitating aspect of the learning process. The question, in the present context, is what do we now know about assessment practices that are evidence–based in terms of providing an important heuristic for significantly improving student learning and attainment?

Firstly it is now clearly recognized that assessment is not simply a means to measure learning that has already occurred, but is a major facilitator in the learning process itself. As Boud (1988) illustrated:

> There have been a number of notable studies over the years which have demonstrated that assessment methods and requirements probably have a greater influence on how and what students learn than any other single factor. This influence may well be of greater significance than the impact of teaching or learning materials. (p. 35)

In my experience, whether teaching pupils in the mainstream school context, or on Master's degree courses, learners typically focus on what is assessed. I have taught many students on Master's degree programmes who have been very explicit about what their main priority is, and that was passing and getting a good grade. To do this they want to know what to learn and how to apply it to meet these goals. I am not saying there is no intrinsic motivation in their overall approach, but assessment largely drives the learning process. For higher education programmes, there is emphasis on complex understanding and application, which inevitably pushes students towards engaging in good thinking. However, this is not always seen as a pleasurable activity, even for Master's degree students. Many like it when you model the answers for them, and why would they not, as many do the programme after a long day's work and are already suffering from cognitive strain. Similarly in school, if assessment is mainly focused on memorizing large bodies of factual content knowledge, then that's what most motivated students will do. Teachers talking about learning for passion and the importance of becoming self-directed lifelong learners will mean little when the marks on test papers suggest otherwise.

Assessment serves many purposes for different stakeholders (e.g., selection, maintaining standards, identifying and diagnosing learning difficulties, enhancing teaching). Most significant, in this context, is the important role that formative assessment (e.g., where learning is focused on supporting the learning process) plays in influencing student attainment, especially through the process of ongoing two-feedback. This is in contrast to summative assessment (e.g., where a terminal assessment decision is made and the learner either passes or fails or is graded accordingly). The high impact of feedback on attainment (e.g., the average effect size of 0.79, which is twice the average effect of all other schooling effects) is well documented by Hattie (2009). However, it is only relatively recently that this has been subjected to detailed scrutiny in terms of its impact and how it works on specific aspects of the learning process.

There are a number of interrelated aspects that contribute to the high impact potential of feedback on learning. As prior learning is always the entry point for new learning, new learning must find some anchor point in prior learning otherwise it is essentially a foreign language. This is equally true for feedback. As feedback represents new learning, it must be able to connect meaningfully to existing learning for it to be effective in building understanding. For example, if students are unclear about what they are supposed to be learning, even good feedback may not make much sense. Hence, good feedback is very much an ongoing dialogue between teacher and learners (as well as between learners) to identify gaps in knowledge, understanding and skills, as well as directing the necessary action to resolve these gaps.

It's not surprising that quality feedback has such high impact in terms of effect size on student attainment, as it connects to so many aspects of the learning process. However, to maximize the positive impact of feedback on attainment a number of conditions need to be effectively met. Sadler (1989) summarized these as follows:

- What good performance is (i.e. the learner must possess a concept for the goal or standard being aimed for)
- How current performance relates to good performance (for this, students must be able to compare current and good performance)
- How to act to close the gap between current and good performance.

The manner and types of questions asked during feedback sessions is also very important. A friendly supportive manner is essential to create a level of rapport in which learners feel comfortable in providing feedback to the teacher. Once established, teachers can then ask students focused questions in order to ascertain what they know and understand, identify specific gaps in knowledge and understanding, as well as misconceptions, thus enabling learning to become more visible to both.

Furthermore, effective teachers, just as they adjust their communication style to different student personalities, also adjust their provision of feedback accordingly based on specific student need. For example, Hattie and Yates (2014) suggest that novices require more specific task related corrective feedback, to be gradually replaced with more process feedback as they become increasingly proficient and self-regulated in their learning. What this means is that, initially feedback will focus on detecting errors in what students are doing on a task, and help to reduce and eventually eliminate these errors. Such feedback will include showing students what went wrong, examples of correct performance and ways to improve on these particular types of learning tasks. Process feedback is more focused on how the students are tackling the tasks given, such as their thinking (e.g., analysing, comparing and contrasting, evaluating) and the learning strategies they are using. In providing feedback it is often the case that both aspects are needed and this is where the teacher's judgement and skilful action are most impactful. As students become increasingly proficient, feedback is usually more focused on their abilities to monitor and evaluate their own learning, both at cognitive and affective levels (e.g., metacognition). Questions of how much feedback and the frequency of feedback, as with all aspects of differentiated instruction, will depend on the situation and learners' readiness. As Hattie (2012) summarized:

> The key is the focus on decisions that teachers and students make during the lesson, so most of all the aim is to inform the teacher of student judgements about the key decisions: 'Should I relearn…Practice again…To what?' and so on. (p. 143)

There is now increasing coverage in the literature on 'assessment for learning' or formative assessment, and how assessment methods, from an evidence-based approach, can be used to maximize the use of feedback for enhancing student attainment (e.g., Petty 2009). The strategic use of ongoing formative assessment is an essential part of the overall assessment strategy and, as Perkins (1992) suggests, once considered thoughtfully:

> Teaching, learning, and assessment merge into one seamless enterprise. (p. 176)

Core Principle 3: *Learners' prior knowledge is activated and connected to new learning* is in one large part an exercise in formative assessment, focusing on

eliciting important feedback data relating to what students already know, don't know and what areas are still 'fuzzy' requiring further exploration through good questioning. Furthermore, feedback is not something that occurs only between the teacher and individual students but can, and should be, an ongoing collaborative process with students as active participants. One method that I have found particularly useful is that of peer assessment for a number of reasons, as Petty (2009) fully summarized:

1. Students come to understand the nature of good work more deeply, as they must use this understanding to judge a peers work. This helps them understand their goals as learners, for example how marks are gained and lost. These goals are learned from concrete to abstract; this is the most powerful way to learn.
2. They learn other ways of approaching a task than the approach they used.
3. They become more reflective about their own learning and gain understanding by discussing disagreements. For example, if students realize they did one calculation wrong because they confused a sine with a tangent that is very helpful.
4. Students can do more work than you can mark.
5. Students tend to take pride in work that will be peer assessed: they are more likely to complete it and to write more neatly than if you assess it.
6. Students accept criticisms from each other that they would ignore if given by you! For example 'Your writing is really hard to read.'
7. Students greatly enjoy this method, and both 'helpers' and 'helped' learn if they support each other constructively. (The standard of discussion is commonly higher than you expect!)
8. It helps to develop the skills required for self-assessment. (p. 63)

Also, feedback from students is invaluable in helping teachers appraise the effectiveness of their own teaching strategies. Unfortunately many fail to take advantage of this easy-to-use approach to monitoring the effectiveness of their teaching on an ongoing basis, and are often dismayed and surprised when they receive negative feedback at the end of a course programme. Teachers who are in regular dialogue with their students concerning learning and collaboratively finding ways to enhance attainment are rarely surprised by the findings of programme evaluation exercises, and their feedback is likely to be very positive. The very act of seeking feedback from students concerning what aspects of the instructional process are most useful (and least useful) in supporting their learning, is supportive of learning in two particularly powerful ways. Firstly, from a technical point of view it enables the teacher to identify what is working well, what is not working well, and helps to understand students' learning at specific times and therefore make thoughtful situated modifications in instructional strategy. Secondly, and equally important, this will have a strong subconscious affective impact in terms of communicating interest and care and concern for their learning. As a teacher, this will certainly contribute to enhancing the perception that you are both 'well organized' and a 'nice person', the two major organizing constructs of student's conception of a good teacher, according to Willingham (2009). This will be explained and illustrated

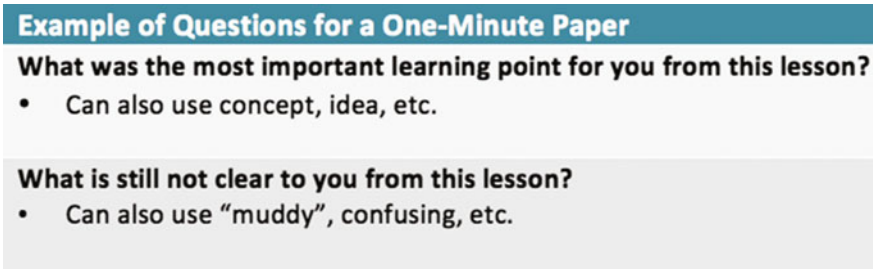

Fig. 2.11 Example of a one-minute paper

in Chap. 4. Obtaining feedback on one's teaching is not difficult or time-consuming. It can be done very informally as part of the everyday dialogue of instruction. For example, I make it a routine practice of making it clear and explicit to students that they must let me know if they are experiencing difficulty in understanding a particular concept, or if am going too fast or too slow, etc. With new groups I usually initiate this with some humour by referring to my East London accent, which does not use the letter H, and they may need to check what I'm saying occasionally and 'pull me in a bit' if I am drifting into local East London diction. A particularly useful and easy to use method for obtaining key student feedback is what is often referred to as a 'One-Minute Paper' (Fig. 2.11: Example of a One-Minute Paper). This is a simple feedback questionnaire of only two question areas, one identifying a key positive aspect of the lesson and the other one identifying a possible negative or limited aspect of the lesson. It can be framed in various ways, as well as modified in terms of focus or terminology. Essentially it explicitly communicates your intention to take into account their experience and identify what seems to be working well and also what may not be working well, from their perspective. Perhaps most importantly this opens up an ongoing dialogue and conversation with students on their learning, enabling better diagnosis of what the areas of difficulty are and how best to situated the instructional approach for them. Good feedback, when used effectively is another of those "Russian Dolls" (Hattie 2009) and it supports learning, both for students and the teacher.

The importance of this heuristic is fundamental to the whole instructional process as ultimately we are seeking to develop in our students the capability to become self-directed learners; that is be able to plan, monitor and evaluate their own learning. As Hattie (2012) concluded:

> …all students should be educated in ways that develop their capability to assess their own learning. (p. 141)

2.2 Using the Core Principles Thoughtfully: The Fly Fishing Analogy

For the uninitiated, fly fishing involves a fairly sophisticated fishing technique in which an artificial fly is cast to catch trout. However, whether or not the fisherperson catches trout, involves much more than this. Choosing the strategy, type of fly, identifying the species of trout in the location, interpreting the impact of weather conditions are some of the critical considerations in catching trout. The expert fisherperson negotiates these almost intuitively and catches fish regularly. Suffice to say, as a novice fly-fisherman, I caught few trout and never reached any great heights of expertise.

Fly fishing is a useful analogy when applying the core principles of learning in that both involve solid knowledge bases relating to the design and conduct of the respective activities. Similarly, they are also mediated by the situated context in which they are enacted in that both the fly fisherperson and the teacher have to deal with the here and now environmental situation. For the fly-fisherperson, there is a need to carefully consider such factors as the nature of the water locality (e.g., river, lake or sea), type of trout inhabitants in the locality, season of year and prevailing weather conditions. For the teacher key considerations include the nature and composition of the student group (e.g., prior knowledge and competence levels, motivational status), classroom resources and time of the day. Based on their knowledge and their framing of the particular situated context, they select methods and resources, and create strategies to try to produce good results—whether defined in terms of 'trout caught' or 'students taught'.

In teaching, while the core principles of learning are enduring heuristics in the design of the learning experience and the conduct of teaching, their relative importance as focal points in the design and teaching process is typically mediated by such situated factors. For example, if I am aware that a learning group has many students who have a generally low intrinsic motivational level for the subject, I will give more thought concerning how best to incorporate appropriate motivational strategies and work on creating a positive psychological climate as the central consideration. In this situation, I may 'sacrifice' cognitive considerations for better motivational or affective outcomes, at least in the short term. However, I would maintain a strong focus on avoiding cognitive overload and developing some mastery of key skills as priority pedagogic features. In contrast, when teaching fee-paying students on higher degree programmes motivating them may not be such a central concern, though they typically appreciate it anyway. This thoughtful and situated application of the Core Principles of Learning has been well captured by Darling-Hammond and Bransford (2005):

> …teachers not only need to understand basic principles of learning but must also know how to use them judiciously to meet diverse learning goals in contexts where students differ in their needs. (p. 78)

2.3 Summary

This chapter has outlined and illustrated key heuristics—Core Principles of Learning—for planning and conducting the practices of teaching. They are underpinned by current and established knowledge relating to human learning and research on what methods are most effective. The extent to which cognitive scientific principles (e.g., Core Principles of Learning) can be said to constitute an essential ***Pedagogy Literacy*** for the planning and facilitation of learning may rest on how other literacies are framed and on what basis. The term literacy has been typically used in the context of language acquisition and use. For example, persons who cannot read, speak or write effectively are sometimes referred to as 'lacking in literacy'. When such competences are severely lacking, the term illiteracy is often used. How lacking one must be in these areas to meet the criteria of illiterate is a value judgement to some extent and reflects the proficiency standards used. Whatever the standard, I certainly meet such labelling in terms of my fluency in foreign languages. As a Brit I am somewhat ashamed, in my travels, to have to explain that the only language I have any acceptable literacy in is English. More recently, the term literacy has been applied to a wide range of domain areas (e.g., computer literacy, media literacy, political literacy). This is similar in many ways to the proliferation of different intelligences (e.g., emotional intelligence, social intelligence, cultural intelligence). Whether different literacies or intelligences merit such grand description is open to debate, but there are clearly valued areas of human capability implicit in these designations. In the present context, *Pedagogic Literacy* would meet such criteria. Willingham's (2009) summary illustrates this in practice:

> Principles of physics do not prescribe for a civil engineer exactly how to build a bridge, but they do let him predict how it is likely to perform if he builds it. Similarly, cognitive scientific principles do not prescribe how to teach, but they can help you predict how much your students are likely to learn. If you follow these principles, you maximize the chances that your students will flourish. (p. 165)

Indeed, once teachers have a strong pedagogic literacy as well as the technical knowledge and skills to use a range of instructional methods thoughtfully and skilfully, they are in a position to evaluate the impact of their teaching on student learning and attainment from an evidence-based approach. It is then possible to achieve what Hattie (2009) emphasized as fundamental to improvement:

> The ultimate requirement is for teachers to develop the skill of evaluating the effect that they have on their students. (p. 36)

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http://www.springer.com/978-981-287-533-4

Creative Teaching
An Evidence-Based Approach
Sale, D.
2015, XVII, 186 p. 22 illus., 21 illus. in color., Hardcover
ISBN: 978-981-287-533-4