

PART 1

INTRODUCTION TO TEACHING AND LEARNING



CHAPTER 1

THEORIES OF LEARNING AND INTELLIGENCE



Key Points

In this chapter, you will learn about:

- the main elements of behaviourist learning theory
- what Piaget and Vygotsky had to say about learning, and its relevance today
- the meaning of IQ and traditional theories on intelligence
- Gardner's theory of multiple intelligences
- the main elements of cognitive and brain research.

Introduction

In this chapter, we will discuss the main theories on how children learn. This is of course an important issue in teaching, as to be effective we need to try and teach in a way that reinforces how people naturally learn. Theories of learning and intelligence are many and diverse, and we can't look at all existing theories in one chapter. What we will do instead, is focus on some of the theories that have been most influential in education over the years.

IQ Theory

One of the first theories on learning to gain widespread currency in education was IQ (Intelligence Quotient) theory.

IQ theory is mainly interested in the concept of intelligence, which is seen as determining people's ability to learn, to achieve academically and therefore to take on leading roles in society. IQ theorists, like William Stern, who was one of the developers of the theory in the early part of the twentieth century, claimed that core intelligence was innate. Many psychologists in the USA and Europe supported that conclusion and psychologists like Terman and Binet developed instruments specifically designed to test people's innate intelligence. These were analysed using the newest statistical methods such as factor analysis, developed by Thurstone and Spearman. These analyses showed that all the items (questions) in those tests essentially measured one big factor, called G, or 'general intelligence'. Therefore, the theory states that people have one underlying general intelligence, which will predict how well they are able to learn and perform at school (Howe, 1997).

A major point of discussion is whether intelligence as measured by IQ tests is innate or learned. The initial theories largely stressed the innate nature of intelligence, seeing it as an inborn property. Subsequent research has, however, clearly shown that IQ can be raised through educational interventions, which means that it cannot be totally inborn. The successful CASE programme in the UK, for example, does just that (Adey and Shayer, 2002). Another fact that points to the 'learnability' of IQ is that average IQ test scores have been increasing steadily over the past decades in all countries where they have been studied (Flynn, 1994). When we are testing someone's IQ, we are therefore testing his or her education level at least as much (if not more) than whatever innate ability he or she may possess. Also, it has become clear that children's IQ test scores are strongly influenced by their parents' so-called cultural capital, that is people's cultural resources (how many books they read, what media they access and so on). This in turn is strongly determined by their socio-economic status, or their position in the social class system (Gould, 1983; Howe, 1997; Muijs, 1997).

As well as the issue of whether IQ is innate or learnt, the whole theory of IQ has been heavily criticized for many years now. These criticisms focus on a number of areas. The first of these is the methods used to measure intelligence, which produced G. While we don't want to go into a discussion of statistics here, it is fair to say that the factor analysis method these researchers developed was specifically designed to come up with one big underlying factor, and usually does. If you use different methods, you are likely to find far more factors. Therefore, in many ways, it is pre-existing theories which led to the development of methods designed to confirm these theories (Muijs, forthcoming). The theory of intelligence also focuses purely on 'academic' intelligence, and so disparages

other skills and abilities. As we will see, recent theories have taken a different approach on these matters (Gardner, 1983).

The idea that there is one measurable factor that distinguishes people has also been widely misused. One of the earliest uses of IQ tests was to look at differences in intelligence between particular groups in society, which were then said to be differently intelligent (and by implication more or less suitable to take on leading roles in society). The findings of these studies tell us far more about the societies in which they were carried out than about the 'intelligence of different groups' (which as a matter of fact does not differ significantly). Thus, in the USA, research concentrated on finding differences between racial groups (whites scoring higher than blacks), in France on differences between genders (men scoring higher than women) and in the UK on differences in social class (the higher classes obviously coming out as more intelligent than the working class) (Blum, 1980; Gould, 1983).

Notwithstanding these criticisms, it would be wrong to reject IQ theory. There is evidence that an underlying general aptitude influences how well students perform in a variety of subjects. There is a far stronger correlation between students' performance in maths and English than is often realized, for example. Therefore, the evidence does suggest that such a thing as general intelligence may exist and be a significant predictor of student achievement and learning.

Multiple Intelligences

As we saw in the previous section, the theory of IQ stresses the existence of one overarching intelligence, a view that has become increasingly controversial over time. For many decades, however, no alternative theory was able to overcome the dominance of IQ theory whenever ability and intelligence were studied. This changed in the early 1980s, with the publication of *Frames of Mind* by Howard Gardner (1983), in which he set out his theory of 'multiple intelligences'.

Gardner takes a view that is very different from that of IQ theory. According to him, people do not have one general intelligence, but are characterized by a range of intelligences instead. So, rather than being globally intelligent, I may be particularly strong in certain areas, for example mathematics, while someone else may be particularly strong in another area, for example physical sports.

Gardner (1983, 1993) distinguishes seven main types of intelligence:

1. **Visual/Spatial Intelligence.** This is the ability to *perceive the visual*. Visual/spatial learners tend to think in pictures and need to create vivid mental images to retain information. They enjoy looking at pictures, charts, movies and so on.

2. **Verbal/Linguistic Intelligence.** This is the ability to use *words and language*. These learners have highly developed auditory skills and are generally elegant speakers. They think in words rather than pictures. This is the ability that can be measured by the verbal part of IQ tests.
3. **Logical/Mathematical Intelligence.** This is the *ability to use reason, logic and numbers*. These learners think conceptually in logical and numerical patterns, making connections between pieces of information. They ask lots of questions and like to do experiments. The non-verbal portion of traditional IQ tests largely measures this intelligence
4. **Bodily/Kinaesthetic Intelligence.** This is the *ability to control body movements and handle objects skilfully*. These learners express themselves through movement. They have a good sense of balance and eye-hand coordination. Through interacting with the space around them, they are able to remember and process information.
5. **Musical/Rhythmic Intelligence.** This is the *ability to produce and appreciate music*. These learners think in sounds, rhythms and patterns. They respond strongly to music and rhythm. Many of these learners are extremely sensitive to sounds occurring in their environment.
6. **Interpersonal Intelligence.** This is the *ability to relate to and understand others*. These learners can empathize and see things from other people's point of view in order to understand how they think and feel. They are good at sensing feelings, intentions and motivations. Generally, they try to maintain peace in group settings and encourage cooperation. They can be manipulative.
7. **Intrapersonal Intelligence.** This is the *ability to self-reflect and be aware of one's inner states*. These learners try to understand their inner feelings, dreams, relationships with others, and strengths and weaknesses. Their strength lies in the ability to be self-reflective (Gardner, 1983, 1993).

A misconception that exists about this theory is that one intelligence is necessarily dominant. This is not really the case, as all of us will possess all intelligences to some extent. It is also important to remember that doing something will usually require use of more than one intelligence.

To some, it might seem that this choice of different intelligences is somewhat arbitrary. Gardner's theories are sometimes seen as somewhat unscientific, a seemingly random selection of intelligences. This is a misconception. In fact, Gardner uses a number of quite stringent criteria for defining an intelligence, taken from a variety of disciplines such as developmental psychology and cultural anthropology:

- Isolation as a Brain Function. A true intelligence will have its function identified in a specific location in the human brain. This can increasingly be determined using the latest brain-imaging techniques.

- **Prodigies, Idiot Savants and Exceptional Individuals.** In order to qualify as an intelligence, there must be some evidence of specific ‘geniuses’ in that particular area.
- **Set of Core Operations.** Each true intelligence has a set of unique and identifiable procedures at its heart.
- **Developmental History.** A true intelligence is associated with an identifiable set of stages of growth, with a mastery level which exists as an end state in human development.
- **Evolutionary History.** A true intelligence can have its development traced through the evolution of our species as identified by cultural anthropologists.
- **Supported Psychological Tasks.** A true intelligence can be identified by specific tasks which can be carried out, observed and measured by clinical psychologists.
- **Supported Psychometric Tasks.** Specifically designed psychometric tests can be used to measure the intelligence. A psychometric test is a standardized test used to measure a specific psychological facet, such as personality or intelligence.
- **Encoded into a Symbol System.** A true intelligence has its own symbol system which is unique to it and essential to completing its tasks (Gardner, 2003).

Misuses of Gardner’s theory

Gardner’s theory has proved both popular and controversial in education, and both are closely linked. As often happens in education, psychological theories are taken on board by educators or commercial consultants who do not understand them well and produce a low-level vulgarized version for use in schools. Gardner himself for a long time remained silent on the issue of use of MI theory in the classroom, but more recently has pointed to a number of misuses he sees of his theories in education:

1. Sometimes it is inferred that all subjects or concepts need to be taught using all seven intelligences. According to Gardner (1995), while most topics can be taught in a number of ways, it is usually a waste of time to try and teach a topic using all seven intelligences.
2. Going through the motions of using an intelligence does not in itself lead to learning. Gardner gives the example of some teachers getting children to run around as a way of exercising bodily/kinaesthetic intelligence.
3. Gardner (1995) also does not believe that the use of materials associated with a multiple intelligence as background (e.g. playing music in the classroom) will do anything to aid learners who are strong in that area.
4. Sometimes teachers claim they are exercising pupils’ multiple intelligences (in this case musical/rhythmic intelligence) by getting them to sing or dance while reciting something like a times table. While this may help them remember it,

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Gardner (1995) describes such a use of MI as trivial. What educators should encourage instead is thinking musically or drawing on some of the structural aspects of music in order to illuminate concepts in other fields (like maths).

5. The use of various measures or instruments that grade intelligences is seen by Gardner as being directly in opposition to his views of intelligence as something that occurs when carrying out activities within cultural settings.

While Gardner's theories have been widely influential in education recently (although, as mentioned above, not always in the most helpful way), they have also been subject to criticism. One criticism focuses on what is seen as a lack of testability of Gardner's theories. This is seen to result from an ambiguity of the theory, in that it is not clear to what extent the intelligences are supposed to operate separately or interconnectedly. The fact that the existence or not of an intelligence is not testable experimentally and cannot be accurately psychometrically assessed is also critiqued (Klein, 1997), although Gardner would argue that this critique misunderstands the theory which sees intelligences as operating in cultural action. Critics claim that Gardner doesn't provide a clear definition of intelligence and some authors state that what Gardner is studying are in fact cognitive styles rather than intelligences (Morgan, 1996). The criteria he uses have been described as somewhat arbitrary (White, 1998), and Gardner is seen as not providing a clear explanation as to why these and not other possible criteria were chosen (Klein, 1997). Furthermore, the continual addition of new intelligences by Gardner has to lead to doubts as to the rigour of this framework. A number of recent studies have also led to questions over the validity of this theory. Visser et al. (2006), for example, found that when tests were developed for each intelligence, there was evidence of a global G factor underlying them, as would be predicted by intelligence theory. This view is also supported by findings from neurological research that show significant overlap between neural pathways controlling different brain functions (Waterhouse, 2006). In general, a lack of empirical evidence is a major problem with this theory, as over 25 years after its initial publication we should by now have been able to collect evidence to support it (Waterhouse, 2006). Arguments made to counter this problem, are that new tests are required for these domains, that theories don't necessarily require empirical data to be useful. Some test of real-world relevancy is necessary, and until this is forthcoming we have to conclude that this theory is not supported.

Behaviourism

One of the earliest theories to focus explicitly on learning rather than on intelligence is called behaviourism. Behaviourism was developed in the 1920s and

1930s by psychologists such as Skinner, Pavlov and Thorndike. While obviously somewhat outdated now, this theory still has a strong influence on educational practice, if not theory.

Behavioural Learning Theory emphasizes change in behaviour as the main outcome of the learning process. Behavioural theorists concentrate on directly observable phenomena using a scientific method borrowed from the natural sciences. The most radical behaviourists, such as Skinner, considered all study of non-observable behaviour ('mentalism') to be unscientific (Hilgard, 1995; O'Donohue and Ferguson, 2001). In recent years, however, most researchers and psychologists in the behaviourist tradition, such as Bandura (1985), have expanded their view of learning to include expectations, thoughts, motivation and beliefs.

Learning, according to behaviourists, is something people do in response to external stimuli. This view was an important change over previous models, which had stressed consciousness and introspection, and had not produced many generalizable findings about how people learn.

When they studied learning, behaviourists usually did so using experiments conducted with animals like dogs as well as humans. This is because, being against 'mentalism', behaviourists think that it is largely external factors which cause our behaviour. The basic mechanism through which this happens is conditioning. According to behaviourists, there are two different types of conditioning:

Classic conditioning occurs when a natural reflex responds to a stimulus. An example of this comes from Pavlov's experiments with dogs. In order to process food, dogs need to salivate when they eat. As all dog owners will know, what happens is that dogs will start to salivate even before eating, as soon as they have smelt or seen food. So, the external stimulus of food will cause the dog to salivate. It has become a habit that is conditioned. When confronted with particular stimuli, people as well as animals will produce a specific response.

Behavioral or operant conditioning occurs when a response to a stimulus is reinforced. Basically, operant conditioning is a simple feedback system: if a reward or reinforcement follows the response to a stimulus, then the response becomes more probable in the future. For example, if every time a pupil behaves well in class s/he gets a reward, s/he is likely to behave well next time.

Rewards and punishments are an important part of behaviourist learning theory. Initial experiments with dogs and rats convinced these psychologists of the importance of the use of rewards and punishments to elicit certain desired behaviours such as pushing a lever, in these animals. Over ensuing decades, these findings were further tested and refined with human subjects, and became

highly influential in education. Pleasurable consequences, or *reinforcers*, strengthen behaviour, while unpleasant consequences, or *punishers*, weaken behaviour. Behaviour is influenced by its consequences, but it is influenced by its antecedents as well, thus creating the A(ntecedents)–B(behaviour)–C(onsequences) chain. Skinner's work concentrated mainly on the relationship between the latter two parts of the chain (O'Donohue and Ferguson, 2001; Skinner, 1974), and these findings still form the basis of many behaviour management systems in schools, as well as much of the research on effective teaching (e.g. Muijs and Reynolds, 2003).

While this movement remains highly influential, behaviourism has come to be seen as far too limited and limiting to adequately capture the complexity of human learning and behaviours. The idea that learning occurs purely as a reaction to external stimuli has been proved wrong. Activities such as recognizing objects (this is a ball), sorting objects (this is a rugby ball, this is a football) and storing information are clearly 'mentalist' activities – they occur in the head. While of course an external stimulus (perception of an object) is present, behaviourist theory cannot account for the information processing that occurs when we are confronted by stimuli. Behaviourism also cannot account for types of learning that occur without reinforcement – in particular, the way children pick up language patterns (grammar) cannot be explained using a behaviourist framework. Behaviourism also presents problems when the learner is confronted with new situations in which mental stimuli s/he has learnt to respond to are not present. The fact that behaviourism does not study the memory in any meaningful way (they only talk about acquiring 'habits'), is another major problem if we want to explain learning. If we want to really understand how people learn, we have to be 'mentalists' and look at what is going on inside the brain as well as measuring reactions to external stimuli.

However, not all the criticism of behaviourism is justified. Some of it seems to emanate from a dislike of the findings rather than a close look at the evidence. Behaviourism has little place for the role of free will and human individuality. This is never a popular view, and as we have seen this determinism is clearly overdone in behaviourist theories. However, that does not mean that it is entirely inaccurate. While we always like to believe that we are entirely free, our behaviours can to an extent be predicted, in some cases by behaviourist models. That this is true is attested to by the continued usefulness of behaviourist methods in teaching, such as the use of rewards. Not liking certain research findings does not make them wrong, and it is not the job of research and science to simply tell us what we want to hear. Recently, it is fair to say that many neo-behaviourist theories have become popular among scientists looking at the role of evolution in the way we behave. If you read the work of Richard Dawkins (1989), for example, there are clear links with behaviourist psychology.

Piaget and Vygotsky

Piaget and the stages of cognitive development

As well as the behaviourists like Skinner, two other pioneering psychologists who have had a continuing influence on how we view learning are Piaget and Vygotsky.

Jean Piaget was a Swiss psychologist, who started his important work on how children develop and learn before the Second World War. In contrast to the behaviourists, who developed most of their theories using laboratory experiments and rarely looked at the real-life behaviours of children, Piaget's theories were developed from the observation of children.

What these observations taught him was that in order to understand how children think, one has to look at the qualitative development of their ability to solve problems. Cognitive development, in his view, is much more than the addition of new facts and ideas to an existing store of information. Rather, children's thinking changes qualitatively; the tools which children use to think change, leading children of different ages to possess a different view of the world. A child's reality is not the same as that of an adult (Piaget, 2001).

According to Piaget, one of the main influences on children's cognitive development is what he termed **maturation**, the unfolding of biological changes that are genetically programmed into us at birth. A second factor is **activity**. Increasing maturation leads to an increase in children's ability to act on their environment, and to learn from their actions. This learning in turn leads to an alteration of children's thought processes. A third factor in development is **social transmission**, which is learning from others. As children act on their environment, they also interact with others and can therefore learn from them to a differing degree, depending on their developmental stage.

According to Piaget (2001), learning occurs in four stages:

The sensori-motor stage (0–2 years) – the baby knows about the world through actions and sensory information. S/he learns to differentiate her/himself from the environment. The child begins to understand causality in time and space. The capacity to form internal mental representations emerges.

The pre-operational stage (2–7 years) – in this stage, children take the first steps from action to thinking, by internalizing action. In the previous stage, children's schemes were still completely tied to actions, which means that they are of no use in recalling the past or in prediction. During the pre-operational stage, the child starts to be able to do this, by learning how to think symbolically. The ability to

think in symbols remains limited in this stage, however, as the child can only think in one direction. Thinking backwards or reversing the steps of a task are difficult.

Another innovation that starts to take place during this phase is the ability to understand conservation. This means that the child can now realize that the amount or number of something remains the same, even if the arrangement or appearance of it is changed (for example, four dogs and four cats is the same amount). This remains difficult for children in this phase. Children here still have great difficulty freeing themselves from their own perception of how the world appears. Children at this age are also very egocentric. They tend to see the world and the experiences of others from their own standpoint.

The concrete operational stage (7–12 years) – the basic characteristics of this stage are: (1) the recognition of the logical stability of the physical world; (2) the realization that elements can be changed or transformed and still retain their original characteristics; and (3) the understanding that these changes can be reversed.

Another important operation that is mastered at this stage is *classification*. Classification depends on a child's ability to focus on a single characteristic of objects and then to group the objects according to that single characteristic (e.g. if one gives a child a set of differently coloured and differently shaped pens, they will be able to pick out the round ones). Students can now also understand seriation, allowing them to construct a logical series in which A is less than B is less than C and so on. At this stage, the child has developed a logical and systematic way of thinking which is, however, still tied to physical reality. Overcoming this is the task of the next phase.

The formal operational stage (12+) – in this stage, which is not reached by all people, all that is learned in previous stages remains in force but students are now able to see that a real, actually experienced situation is only one of several possible situations. In order for this to happen, we must be able to generate different possibilities for any given situation in a systematic way. Students are now able to imagine ideal, non-existing worlds. Another characteristic of this stage is adolescent egocentrism. Adolescents tend to incessantly analyse their own beliefs and attitudes, and often assume that everyone else shares their concerns and is in turn analysing them.

Piaget's theory has been hugely influential, but has been found wanting in a number of areas. His stages of learning are clearly too rigid. A number of studies have found that young children can acquire concrete operational thinking at an earlier age than Piaget proposed, and that they can think at higher levels than Piaget suggested. Piaget also underestimated the individual differences between children in how they develop, and the fact that some of these differences are due to the cultural and social background of the child. Piaget also did not take

much notice of the way children can learn from others, seeing learning as largely dependent on their stage of development. Notwithstanding that, Piaget's theories have stood the test of time well, and are still a useful way of looking at children's development.

Vygotsky and the role of the environment in child development

Vygotsky was a Russian psychologist, who worked at around the same time as Piaget (although he died younger) and was influenced by Piaget's work. During his lifetime, he was not well-known in the West, but after his death (in particular since the 1960s) he has become increasingly influential.

Vygotsky's main interest was the study of language development, which he believed initially develops separately from thought, but starts to overlap with thought more and more as the child grows up. According to Vygotsky, a non-overlapping part still remains later in life, some non-verbal thought and some non-conceptual speech existing even in adults (Moll, 1992; Vygotsky, 1978).

A major disagreement between Piaget and Vygotsky was that Vygotsky did not think that maturation in itself could make children achieve advanced thinking skills. Vygotsky, while seeing a role for maturation, believed that it was children's interaction with others through language that most strongly influenced the levels of conceptual understanding they could reach (Vygotsky, 1978).

Vygotsky strongly believed that we can learn from others, both of the same age and of a higher age and developmental level. One of the main ways this operates is through **scaffolding** in the **zone of proximal development**. This latter concept, one of Vygotsky's main contributions to learning theory, refers to the gap between what a person is able to do alone and what s/he can do with the help of someone more knowledgeable or skilled than her/himself. It is here that the role of teachers, adults and peers comes to the fore in children's learning, in that they can help bring the child's knowledge to a higher level by intervening in the zone of proximal development. This can be done by providing children's thoughts with so-called scaffolds, which once the learning process is complete are no longer needed by the child. Not all children are as *educable* in this respect, some being able to learn more in the zone of proximal development than others.

Thus, for Vygotsky, it is *cooperation* that lies at the basis of learning. It is formal and informal *instruction* performed by more knowledgeable others, such as parents, peers, grandparents or teachers that is the main means of transition of the knowledge of a particular culture. Knowledge for Vygotsky, like for Piaget, is embodied in actions and interactions with the environment (or culture), but unlike Piaget, Vygotsky stresses the importance of *interaction* with a living representative of the culture.

While Piaget has been criticized for being too strongly focused on developmental learning, Vygotsky's work is seen as suffering from the opposite problem. Vygotsky wrote little about children's natural development and the relationship of that to their learning (Wertsch and Tulviste, 1992). Vygotsky's theories are also in many ways rather general and overarching, and have not been fully worked out (that Vygotsky died at the age of 37 is one reason for this). Vygotsky's contribution lies mainly in his attention to the social aspects of learning, which clearly need complementing by what current research is teaching us about brain functions.

This view of learning as socially constructed strongly influenced the so-called constructivist theories that have followed since then, and has influenced classroom practice. His ideas about pupils' learning in their zone of proximal development have been influential in the development of collaborative learning programmes.

Learning styles

Recently, a lot of attention has focused on differences in pupils' learning styles. While this concept is often evoked, what exactly is meant by different learning styles is not always clear.

Kolb's Learning Styles Theory

One of the most clearly elucidated theories of learning styles is that of Kolb (1995), according to whom learning styles can be ranked along a continuum running from:

1. concrete experience (being involved in a new experience) through
2. reflective observation (watching others or developing observations about our own experience) and
3. abstract conceptualization (creating theories to explain observations) to
4. active experimentation (using theories to solve problems and make decisions).

As is clear from the above, Kolb saw these different styles as a cycle through which all learners should move over time. However, more recently, learning theorists have conceptualized these styles as ones which learners come to prefer and rely on, most learners thus preferring one of these four styles. Litzinger and Osif (1993) called these different types of learners *accommodators*, *divergers*, *convergers* and *assimilators*, and arraigned them along Kolb's continuum as depicted in Figure 1.1.

Accommodators prefer an active learning style. They tend to rely on intuition rather than on logic and like to connect learning to personal meaning and experiences. They enjoy applying their knowledge to real-life situations and don't like to analyze too much. When teaching these learners, it is recommended to

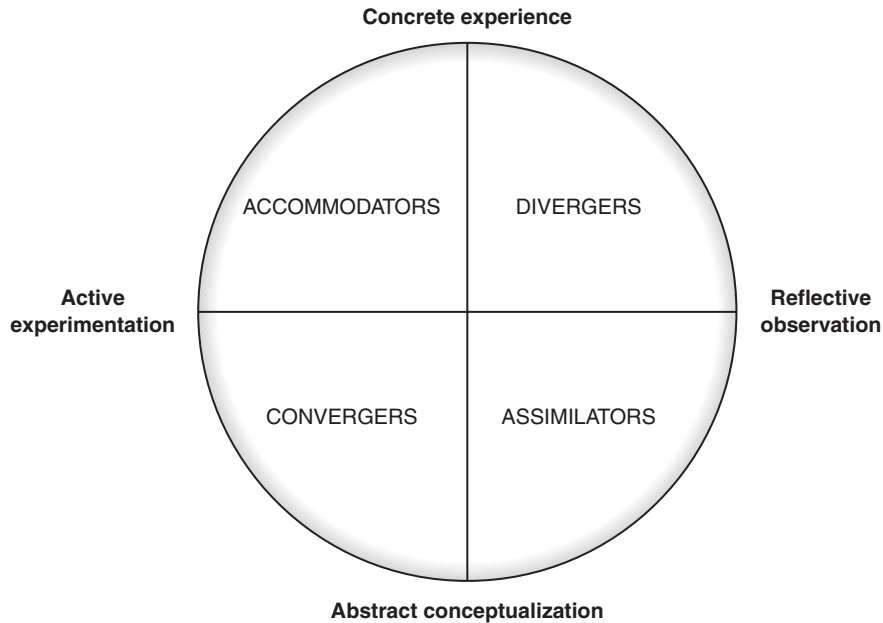


FIGURE 1.1 Kolb's learning styles (from Litzinger and Osif, 1993)

encourage independent discovery and to let learners participate actively in their learning. Interpersonal aspects are important to accommodators, so they will tend to enjoy cooperative learning and group work.

Assimilators like accurate, organized delivery of knowledge and tend to respect the views of those they consider to be experts on the subject. They think logically and prefer abstract ideas. Logic is more important to them than a practical explanation. They will prefer lecture-style lessons or carefully prepared exercises which they will follow closely. However, they also enjoy independent analysis of data and research.

Convergers are mainly interested in the relevance of information. They want to understand in detail how something operates, so they can use it in practice. These learners prefer technical information and are not very interested in social and interpersonal issues. Lessons that suit these learners are interactive, and it can be useful to provide them with real-life problems to explore. Convergers will enjoy doing hands-on tasks, use manipulatives, etc.

Divergers are mainly interested in the 'why' of a system. They like to reason from concrete specific information and to explore what a system has to offer. They like to see things from a variety of viewpoints and like categorizing information. These learners like to use their imagination when solving problems. Divergers enjoy self-directed learning and like independent study, simulations and role play. Information should be presented to them in a detailed, systematic manner.

Kolb's theory is far from being the only learning styles classification in existence. Another classification looks at pupils' different sensory preferences. According to this theory, learners can be classified as preferring either visual, auditory or tactile/kinaesthetic learning (Benzwie, 1987; Dunn and Dunn, 1978), while others add print, interactive and olfactory learners to this typology, leading to the following typology:

- Visual learners learn best by looking at pictures, graphs, slides, demonstrations, films, etc. Colourful, bright graphics can help these learners retain information.
- Auditory learners like to learn through listening both to others speaking and to audio tapes. They will benefit, for example, from preparing listening tapes for review.
- Tactile/kinaesthetic learners learn best through touch and movement, and will therefore like to work with hands-on manipulatives. They will also like role plays and activities which employ body parts as a mnemonic device, such as hand-signals.
- Print-oriented learners prefer to learn through reading.
- Interactive learners enjoy discussions with other pupils in small groups or during paired work.
- Olfactory learners benefit from the use of smell during learning. Associating certain lessons to particular smells can benefit these learners.

The distinction between inductive and deductive learners has also been looked at by learning styles researchers (Hodges, 1994). Inductive learners begin with observations or data and then infer governing rules and principles from these observations. They work from particulars to general principles, and want to know (1) what will the results to be derived help me know?; (2) what are the results?; and (3) how do I derive them? Deductive learners begin with general principles, then deduce consequences and phenomena from these. They work from generalities to particulars and want to know: (1) what are the results to be derived?; (2) how do I derive them?; and (3) how do I use them?

A final distinction that is sometimes made is of that between sequential and global learners. Sequential learners learn one thing at a time. They function well with partial understanding, are good at analysis and convergent thinking, but may sometimes miss the big picture. Global learners, on the other hand, learn in large chunks, don't function well with partial understanding, are good at synthesis and innovation, but are fuzzy on details and may appear to learn more slowly, especially at the beginning of a topic.

The Evidence on Learning Styles

As can be seen from the above, there are a whole number of learning styles, one recent study finding a total of 71 different learning styles frameworks (Coffield

et al., 2004). There are a number of commercial tools on the market designed to measure learning styles among pupils of various ages, such as the Learning Style Inventory (Dunn et al., 1985). However, while a number of these tips make intuitive sense, there is very little research that suggests that teaching to different learning styles actually aids pupils' achievement.

While some studies show a relationship between learning style and achievement (e.g. Burns et al., 1998; Uzuntiriyaki et al., 2003), in general there is very little evidence to support learning styles. In a large scale review of the evidence, Coffield et al. (2004) found that learning styles had weak theoretical grounding and close to no empirical support. Davis (1990) measured the learning styles of a group of second-grade pupils and changed the classroom environment to reflect their preferred learning styles. She found that a control group of pupils whose learning styles had not been taken into account outperformed the experimental group. Similar findings are reported by O'Sullivan et al. (1994), who found mixed effects of an intervention to help at-risk ninth graders through learning-style-based instruction. As well as a lack of evidence on the relationship of Kolb's learning styles to achievement, doubt has been cast on the validity of the concept, with Garner (2000), for example, finding no evidence of the existence of stable learning styles in his study using Kolb's Learning Styles Inventory.

Stahl (1999: 27), reviewing a number of studies on the effects of teaching different learning styles, concluded that: 'These five research reviews, published in well-regarded journals found the same thing. One cannot reliably measure children's learning styles and even if one could, matching children to reading programs by learning styles does not improve their learning.'

Cognitive Theory and Brain Research

What many of the older learning theories (like behaviourism and the theories of Vygotsky) were not able to incorporate was any theory of how the brain works (due to limitations in research methods at the time). More recently, however, brain research and the neurosciences have progressed greatly, and are informing learning theory and education to an ever-greater extent. To some extent, these new methods are confirming theories that we discussed earlier, like Vygotsky's views on learning, but they are also offering us important new insights.

Cognition and Memory

One of the first major theories of learning that explicitly based itself on our emerging knowledge of the brain was cognitive information processing theory.

Especially important in this theory is the role of memory in learning processes. The memory consists of three parts: the sensory buffer, the working memory and the long-term memory.

The memory works as follows: one's experiences (tactile, visual or auditory) are registered in the sensory buffer, and then converted into the form in which they are employed in the working and long-term memories. The sensory buffer can register a lot of information, but can only hold it briefly. Some parts of the information in it will be lost, while other parts will be transmitted to the working memory. The working memory is where 'thinking gets done'. It receives its content from the sensory buffer and the long-term memory but has a limited capacity for storing information, a fact that limits human mental processes. The working memory contains the information that is actively being used at any one time.

The long-term memory has a nodal structure, and consists of neural network representations, whose nodes represent chunks in memory and whose links represent connections between those chunks. As such, nodes can be equated with concepts, and links with meaningful associations between concepts. Together these form schemata, or clusters of information. Activating one item of the cluster is likely to activate all of them (Best, 2000).

This means that memorization and making connections are two crucial components of learning, according to cognitive information processing theory.

Brain Research

Brain research is also telling us that the brain is a pattern maker. The brain takes great pleasure in taking random and chaotic information and ordering it. The implications for learning and instruction are that presenting a learner with random and unordered information provides the maximum opportunity for the brain to order this information and form meaningful patterns that will be remembered. Setting up a learning environment in this way mirrors real life, which is often random and chaotic (Lackney, 1999). The brain, when allowed to express its pattern-making behaviour, creates coherency and meaning. Learning is best accomplished when the learning activity is connected directly to physical experience. We remember best when facts and skills are embedded in natural, real-life activity. We learn by doing. The implications of applying the findings of neuroscience related to coherency and meaning suggest that learning is facilitated in an environment of total immersion in a multitude of complex, interactive experiences which could include traditional instructional methods as part of this larger experience (Kotulak, 1996; Lackney, 1999).

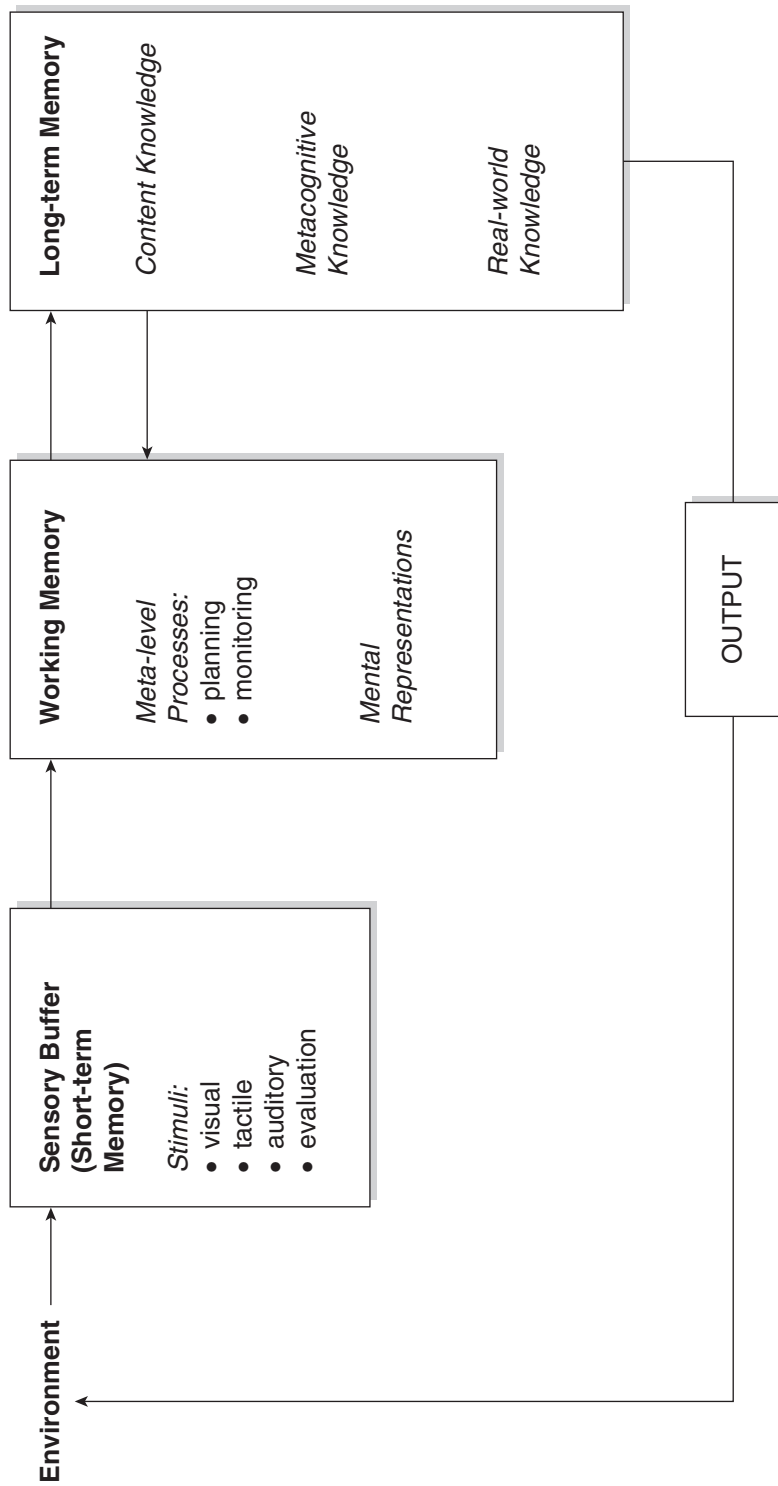


FIGURE 1.2 The structure of memory

Brain research also suggests that the brain is continually growing and changing throughout our life, but that this process is more pronounced at certain developmental stages, which can be seen as a 'window of opportunity' for learning. During childhood, this process of selectively strengthening and pruning connections in the brain is at its most intense, and it is therefore fair to say that this is a crucial period in development. Although this process continues throughout our lives, it seems to be most pronounced between the ages of 2 and 11, as different developmental areas emerge and taper off. During these critical periods, the brain demands specific and extensive (stimulating) inputs to create or consolidate neural networks, especially for acquiring language, emotional control and learning to play music. While one can learn outside of this period, what one has acquired during these windows of opportunity is crucial to what can subsequently be learned (Sousa, 1998).

Another important finding relates to the strong evidence of individual differences between the brain functioning of different learners. While the basic brain architecture is essentially the same, brain scans have shown that, for example, 'while most people, when they recognize an object visually, show increased activity in the back part of their brains, the exact magnitude, location, and distribution of that increased activity varies quite a bit' (Rose and Meyer, 2002). Similarly, learners differ in the strategies they employ to make connections in the brain (Dall'Alba, 2006). This is important for teachers, as it means both that, as constructivist educators have long claimed, each learner will construct knowledge in a slightly different way, and that teaching should be varied to address the different needs and strategies of learners, a finding that confirms the views of those who take a 'multiple intelligences' approach.

The final critical finding from recent brain research relates to the importance of emotion in learning. Emotions can both help and hinder learning. On the positive side, emotions help us to recall information from the long-term memory, through allowing any information received through the sensory buffer to be perceived as positive or a threat. Research suggests that the brain learns best when confronted with a balance between high challenge and low threat. The brain needs some challenge to activate emotions and learning. This is because if there is no stress the brain becomes too relaxed and cannot actively engage in learning. Too much stress is also negative, however, as it will lead to anxiety and a 'fight' response which are inimical to learning. A physically safe environment is particularly important in reducing overly strong levels of stress (Sousa, 1998).

Brain research is a constantly developing research field, and it is highly likely that further developments will in future strongly inform our views on learning, and our teaching strategies. However, one caveat does apply: while I have presented a number of basic findings, this research area is diverse. Findings from different studies do not always agree with one another, and are usually far more

subtle than I have been able to outline in this introductory text. Also, it is always dangerous to try and directly translate findings from brain research into the classroom. This type of research should clearly inform us, but we need to take into account that it has been conducted for very different purposes, and will always need to be matched to educational research findings on effective classroom teaching before it can be translated into effective classroom strategies.



Summary

In this chapter, we have looked at some educationally influential theories of learning and intelligence.

Behaviourism was mainly concerned with how we learn from external stimuli. Using experimental methods, behaviourists looked at how behaviour can be conditioned, for example by providing rewards and punishments.

Piaget used observation to come to his theories of learning. He was particularly interested in the ways children develop. This happens through *maturation*, whereby our genetic growth creates change, and through *activity*, whereby children act on their environment and learn from this. An important finding of Piaget's is that growing up does not just mean knowing more, it actually entails a change in how we think.

Vygotsky concentrated on the ways in which learning is a social process. We learn through interaction with others, both of the same age and of a higher age and developmental level. This process operates through *scaffolding* in the *zone of proximal development*. The ZPD is the gap between what a person is able to do alone and what s/he can do with the help of someone more knowledgeable or skilled than him/herself. Scaffolding refers to the way others can help us to bridge that gap.

IQ theory focuses on the concept of intelligence. According to IQ theorists, there is one underlying, general intelligence that determines our capacity for learning. More recently, Gardner developed his theory of multiple intelligences. Rather than just the one intelligence, Gardner claims that there are a number of different intelligences, such as musical and visual/spatial intelligence. For most tasks, we need to use more than one intelligence.

Brain research is a fast-developing area in psychology, which is producing valuable findings for educators. One of these is that we learn best when challenged but not stressed. Another is the importance of pattern making in the brain. This implies that we need to provide children with the opportunity to create patterns. Finally, brain research confirms that while we can learn throughout our life, early childhood is a key period in developing (the capacity for) learning.

Reflective Questions

1. Thinking about your own practice, in what ways do you think learning theories influence the way you teach?
2. Thinking about your own learning, how well do you think learning theories describe how you learn?
3. What elements of behaviourist theories might be useful to the way we teach?
4. What elements of learning styles theory might be useful to the way we teach?