

# Learning Styles and Other Modern Educational Myths

IVAN SNOOK

*Massey University*

Despite the widespread claims among teachers and teacher educators that teaching is a researched based profession, unsubstantiated myths are rather more common in educational discourse than carefully interpreted research. Among modern “myths” are those relating to “multiple intelligences” “emotional intelligence,” “brain research” (as relevant to educators), and “learning styles”. This paper will

1. Briefly explore some of these concepts and their relationships in educational discourse.
2. Examine in some depth the claims made by those who advocate “brain-based learning” and “learning styles”.
3. Relate the discussion to the political and ideological role played by these fashionable concepts in educational discourse.
4. Briefly discuss the relationship between brain and mind and the significance for educational research.

## Introduction

Some preliminary points:

1. I am by no means an expert in any of the physiological, psychological and technical issues which underly, or are presumed to underly, these various areas of research and study. Rather, I approach them as a philosopher of education. As such, I have an interest in the status of claims and the logic of arguments and a deep seated scepticism about fads and fashions which sound erudite but turn out to have little substance.
2. I do not in any way deny the importance of brain research, for medicine, for understanding human behaviour and even for answering philosophical questions about ‘body and mind’, ‘body and soul’ and the like. Nor do I query the need to adopt a broader approach to education than that based simply on naïve notions of IQ and the centrality of thinking. In so far as notions such as “multiple intelligences,” Emotional Quotient and learning styles remind us that that there is more to education than reasoning or IQ that is fine but there is no need for pseudo-scientific concepts to make such points: they have been made by theorists (eg. Froebel, Rousseau and Dewey) for centuries.
3. Similarly I do not deny that in some way the brain is behind all learning and behaviour and that human learning has profound effects on the developing brain. Indeed, rather than passively developing, the brain is shaped by our experiences.
4. I concede too, indeed insist, that it is important for teachers to know much more than they do about how students learn but to my mind talk of ‘brain based learning’ and ‘learning styles’, far from illuminating learning serves to further obscure it. Worse still, the work on learning styles deceives teachers into thinking that the complex world of learning can be short circuited by simple check lists.
5. Finally, while there are those who question the whole enterprise of doing scientific research on educational processes, describing it pejoratively as positivistic, I am not one of those. On the contrary I believe that we desperately need to know much more about teaching and learning and that careful empirical research is needed to do that. The advances in cognitive science have been influential in

education and in the future should be even more so. My position is that research in education needs to be more scientific not less.

### Common myths

I can begin, relatively uncontroversially, by dismissing three common myths which are refuted by the very science which is presumed to support them. Thus, for example, in a chapter entitled “Mind and Brain” the American National Research Council, states that the field of neuroscience and cognitive science has much to offer in understanding how people think and learn but insists that we must “avoid adopting certain faddish concepts that have not been demonstrated to be of value to classroom practice.”(Bransford, Brown and Cocking 2000, p. 114.) Among these “faddish concepts are:

1. That the left-brain/ right brain dichotomy has significance for educators.
2. That the brain grows in holistic “spurts” which can provide grounds for educational objectives; and
3. That people use only 20% (or some other arbitrary proportion) of their brains.

Since the left brain/right brain has gained such a foothold in educational circles, it is worth quoting another authority who, while supporting the significance of brain research for learning, states clearly: “It has been argued that education currently favours left-brain modes of thinking, which are logical, analytic, dominant and accurate, while downplaying right-brain modes of thinking which are creative, intuitive, emotional and subjective. While encouraging education to involve a variety of tasks, skills, learning, and modes of thinking is probably a good thing, **it is purely metaphorical to call these right-brain or left-brain modes.** [emphasis mine].....Whether left-brain/right brain notions should influence the way people are educated is questionable. Most neuroscientists question the validity of categorizing people as either a left-brain or a right-brain person. **In terms of education, such categorization might even act as an impediment to learning.** [emphasis mine]”(Blaskemore and Frith, 2005, p. 60)

These popular beliefs are rejected by experts in neuroscience. Yet, some of them join educators in making other claims about the significance of neuroscience for teaching and learning which, I submit, cannot be substantiated. Thus, basically in this paper I want to question two major claims about learning and education.

1. I seriously question the claim that current research on the brain is highly significant for educational practice and that teachers need to know about brain functioning if they are to promote learning.
2. I also seriously question the claim, (implicit and often explicit in talk about learning styles) that teachers should target their teaching to the learning style of individuals and so improve their learning.

### Brain research and education

While there is much talk in popular magazines and professional publications about brains in education (Indeed the US Office of Education declared the 1990’s to be “the decade of the brain” and President Clinton referred to it in his state of the union speech in 1997.) full length works have been few. The literature is now beginning to form (eg. Shore, 1997; Slavkin, 2004; Blakemore and Frith, 2005) The major claim of this literature is that “by learning about the development of the brain, teachers and parents can better prepare students not only to learn but to understand how they learn.” (Slavkin, p. 37). Sadly, however, I have been unable to find any evidence that this is so. Many claims are made in the literature but none, in my view, support the thesis regarding the importance of brain research for education. The claims made can be grouped as follows:<sup>1</sup>

1. Claims which sound authoritative but in fact simply announce that at present the brain scientists are ignorant. Some examples are: “Many neuroscientists question whether we know enough about the developing brain to link that understanding directly to educational practice.” (p. 22). “Unfortunately, there is not much research on the development of human brains because the research relies heavily on post mortem brains.”(p. 23). “Whether sensitive periods exist for the transmission of culturally transmitted knowledge systems such as those responsible for reading and arithmetic, is not known.” (p. 31). “Can brain research throw any light on the processes underlying [reading skills]? Probably but the studies have not been done.” (p.48) “Some argue that the teaching of reading should be delayed until six or seven. Others advocate early training in phonological skills and letter knowledge. We cannot say which of these options is better and for whom.” (p. 86).

2. Claims which are probably true and, in their place, of some interest, but have really no bearing on teaching. Some examples are: “Research with EEG has shown that semantic processing activates both the right and the left hemispheres of the brain whereas grammatical processing usually recruits the left hemisphere only.”(p. 45). “The processes the brain uses when reading silently are remarkably similar to the processes used when reading aloud.” (p. 74) “Cab drivers in London have a different size hippocampus than non cab drivers.” (p. 12). “A person reading Braille activates a different part of the brain from a person reading normally.” (p. 130).

3. Claims which are true and educationally relevant but which are already well known from other sources such as educational research or experience. Examples are: “What is particularly important in the case of human learning is interaction with other human beings including language and communication.” (p. 26). “It is important that we identify and if possible treat children’s sensory problems, such as visual and hearing difficulties so that even belatedly they can begin normal functioning (p.32). “A deep knowledge of counting of numbers is largely the result of coaching by adults in the primary school years and so may be considered a clear example of cultural transmission.” (p. 52). “Remedial work must proceed on the principle that there is teaching by patient and slow repetitions of foundational aspects and the provision of explicit rules.”(p. 68). “The teacher needs to make some assumption about what the student knows already and what he or she needs to know to advance their understanding further. The teacher also needs to estimate the degree of interest that the student brings to the task and their receptiveness to teaching.” (p. 149). Since the brain is able to process many different pieces of information at once, “teachers and parents need to utilize this fact and use colourful posters, interesting simulations, and complexity when designing information to be learned (Slavkin, p. 39).

4. Claims which express touching faith in the significance of brain science which at present cannot be shown. Examples are: “It should be possible to find ways of making learning [in adolescence] more rewarding and brain research might have a role to play in this.” (p. 117). “Perhaps one day hypnosis will be exploited to increase learning” (p. 177). “In the future it should be possible to establish systematic programmes of research that reveal, in terms of brain activity, the complex interactions that must arise between factors such as teaching style and learning type.”(p. 150).

Eric Jansen, described on the cover of his latest book as “a leading expert in the translation of brain research into education”, has written some twenty books. His most recent (*Enriching the Brain*, 2006) summarises the significance of brain research for education as requiring: physical activity, meaningful learning, coherent complexity, managed stress levels, social support, good nutrition and sufficient time. (p. 178). Amazingly, the book is lauded by professionals and academics!

It is not surprising, therefore, to find that when schools proudly proclaim the success of brain-based learning the results are far from convincing. Some schools stress the integration of subjects, others favour more physical activity, while others again involve the application of knowledge to, say, producing a

newspaper or television programme. None of these initiatives depend in any way on brain research: they have been advocated and carried out for decades and in some cases for centuries.

I leave the last word to Bruer, a neuroscientist with a deep interest in education: “Educational applications of brain science may come eventually but as of now neuroscience has little to offer teachers in terms of informing classroom practice.” (Bruer, 1997, p. 4).

## Learning Styles

Academics have made careers and publishers have made fortunes out of “learning styles” and there are schools, private training establishments and tertiary institutions which proudly proclaim (even “market themselves” on) their commitment to different learning styles. The idea has been used not only in education, but in nursing, management and business studies. One of the leaders in the movement (Kolb with his well known Learning Style Inventory) produced a reference list of 1004 studies based on his theory alone and these are in most of the languages of the world It can truly be called an “industry.” Yet, on the other hand, a major reviewer has pointed out that “In the last 20 years there has been only a single use of the term ‘learning style’ and three uses of the term ‘cognitive style’ in the Annual Review of Psychology.” (Coffield et al, 2004b, p. 136.) This alone might warn teachers and teacher educators of adopting any simple minded view of learning styles as relevant in the classroom.

In talking to people about my interest in this I have found that everyone almost automatically accepts the idea of learning styles and pays no further attention to my arguments. “Oh yes” they say, “I like to see pictures” or “I prefer to read books” or “I favour hands-on activity” or “I like to listen to a good lecture.” The point is that there is a perfectly acceptable use of ‘learning styles’ which owes nothing to the vast academic literature which bears the name. People here are merely pointing out individual preferences with no claims made about the ontological, psychological or neuroscientific bases for such preferences and, normally, no suggestion that they could not learn from other modes of presentation than the one they favour. I am not interested in disputing such individual preferences. To my mind they have no more significance for education than a person’s preferences for chocolate, fried food, or carbohydrates have for health.

The thesis which I do wish to query contains three major premises:

1. There are a restricted number of learning styles which are conceptually and empirically distinct (various theorists differ as to why: some locate them in the brain, others are quite happy to see them simply as statistical factors.)
2. Each individual is situated primarily in one of these (though mixed modes are possible)
3. People will learn better if these individual learning styles are taken into account. (Theorists differ as to how they are to be taken into account: at one extreme are those who believe that teaching should be targeted to each person’s learning style; at the other, many argue that it is important to *extend* everyone’s learning style. Thus Kolb, already mentioned as well-known, is totally opposed to any targeting.)

The interest began with Jung in the 1920's (eight psychological types) followed by Allport in the 1930's and Klein in the 1950's who added the idea of cognitive style. By 2002 Zhang could say that the interest generated “a research field that embraced a confusing variety of seemingly different yet similar constructs.” (Charlesworth, 2004, p. 104). By 2004, a major reviewer found 71 models of learning styles which, for review purposes, he reduced to thirteen major models. Each of these produced their own favoured categories: convergers/divergers, verbalisers/imagers, holists/serialists, activists/reflectors, assimilators/explorers, globalisers/analysts and so on and on: the list seems almost endless. There is little attempt in the literature to relate one model to another so questions like: ‘are convergers similar to holists?’ are almost never discussed The reviewer states: “The field of learning styles research as a whole is characterised by a very large number

of small scale applications of particular models to small samples of students in particular learning contexts.” (Coffield et al 2004b, p. 1). I found one study in which two models had been compared: Boyle et al compared the Sternberg-Wagner Thinking Styles Inventory (TSI) to D’Zurilla’s Social Problem-solving Inventory (SPSI) by factor analysis of responses of 118 students. They concluded: “Styles are elusive and difficult to pin down and the weak correlations found in the current study are consistent with previous studies where the evidence for stylistic distinctions has not always been robust and convincing.” (*Bridging Theory and Practice*, 2003, p. 77.)

The desire to relate it to education led Kolb to design the Learning Style Inventory (LSI) which remains the best known of the inventories. He held to four learning styles: Accommodator, Diverger, Assimilator and Converger. In 1986 this model was taken up by Honey and Mumford who developed another model: activist, reflector, theorist, pragmatist. This led to the Learning Style Questionnaire (LSQ). The LSQ was further developed into a six point Likert scale widely used for studies of hospitality management. In their exhaustive and thorough review of the models, Coffield et al (2004b) did find some studies where positive correlations had been found for predictions based on a model, but:

(1) These were matched by others which found no correlations and others which found negative correlations. In one major study in Great Britain containing over 200 subjects, “the intervention group did poorer than the control group.” (2004, p. 32). Mainemelis, et al (2002) summarised the evidence relating to LSI by reference to two unpublished doctoral theses in the US. The first analysed 81 studies; they found that 62% of the studies supported the theory, 16% were ambiguous and 22% failed to support it. The second analysed 101 quantitative studies: 49 found were supportive, 40 were ambiguous and 12 found no support. Doubt has also been cast on even the positive findings.

Thus (2) Many of the positive studies failed to make any allowance for “intervention effect.” Sometimes called the Hawthorne Effect this arises from the fact that regardless of the variables being tested, groups often show improved results simply on the basis of being treated differently over an extended period.

(3) There are recurrent design problems. For example, the studies are normally based on the ‘self report’ of individuals (often students who have already learned about the models). The results may often be distorted by a desire to please, a sense of what might be the “better answer” or out of cussedness. Finally, few of the studies estimate the reactive effects of pre-testing which can alert subjects to the “right” answers.

(4) Many of the positive studies have been carried out by the people who develop and advocate the particular model or by their students and many of them are themselves in the business of marketing and selling their inventories and other materials. Indeed, there are cases of proponents refusing to acknowledge any evaluations unless they are carried out by persons who have undergone training in the model. Curry notes that many of the studies have been carried out by graduate students of staff with a vested interest. (Curry, 1990, p. 54). Coffield et al go as far as suggesting: “The commercial industry that has grown around particular models makes independent researchers think twice before publicly criticising either the shortcomings of the models or the hyperbolic claims made for them.” (2004 b, p. 137)

Not surprisingly then the reviewers come to the following conclusions: “research into learning styles is characterised as small scale, non-cumulative, uncritical and inward looking” and “there has been a proliferation of concepts, resulting in a large number of dichotomies, symptomatic of conceptual confusion, and of a serious failure of cumulated theoretical coherence.” (Coffield et al. 2000, p. 115).

My conclusion is that the claims that (1) *There are a restricted number of learning styles which are conceptually and empirically distinct and that* (2) *each individual is situated primarily in one of these styles*, are refuted by the literature which is supposed to support them.

## Learning styles and teaching

I turn now, to the claim which is of most interest to teachers that

*(3) People will learn better if these individual learning styles are taken into account.*

1. It seems to me to be a priori highly unlikely that a field of research which is so fragmented, conceptually confused, and plagued by difficulties of reliability and validity, would be of much use to busy teachers handling the complex world of classroom.
2. It is difficult to know what it means “to take learning styles into account.” On one simple account, teachers are supposed to vary their teaching to take account of the learning styles of individuals: this is often called “matching” or “targeting” and is probably what most teachers assume that learning styles are about. Many proponents of learning styles, however, reject this holding that instead one ought to extend students’ learning styles by encouraging them to use all sorts of “learning styles.” Kolb, whose LSI is frequently used for matching, explicitly rejects it and advocates exposure to a variety of styles. In practice this often becomes the totally unproblematic demand that teachers vary their methods of teaching, a suggestion that has been made for decades, if not centuries, and in no way depends on “learning styles.”
3. If a teacher decided to “take learning styles into account” which of the 71 identified models should she choose and on what basis would she choose?
4. If all these considerations were not enough, there is no empirical justification for believing that the use of learning styles improves teaching or learning, reviewed the evidence and found nine studies which showed that learning is more effective when there is matching, and nine showing it to be more effective when there is a mismatch. One review found that “For each research study supporting the principle of matching instructional style and learning style there is a study rejecting the matching hypothesis.” (Smith, Sejar and Townsend, 2002, p. 411)

My conclusion then is this. **All the claims about learning styles are false.** *People cannot be reliably assigned to learning styles which are conceptually and empirically distinct and there is no sound evidence that students will learn better if their learning styles are taken into account. Learning styles are indeed a modern educational myth.*

## Why does the model persist?

Despite all that has been said, proponents of learning styles do not give up. This is true not only of teachers who, for one reason or another, are wedded to one of the models but also of those who know only too well the severe limitations of the research on which it is based. Even Coffield et al (2004b) who reviewed the models with devastating effect, cling to the notion that some of the models might be worth persevering with, although their final comments are not optimistic (p. 144). We need to ask therefore why such beliefs persist despite the negative findings outlined above. There seem to be a number of reasons of various sorts.

1. Among educators there is an intuitive and, perhaps, well founded belief that solutions to many of the problems of education must be located in the approach to learning exhibited by individual students. Teachers everywhere notice that students differ enormously in their motivations and uptake of the ideas and information imparted. For generations, teachers have believed that they must target their teaching to the interests and prior knowledge of learners. Thus, they are more than ready to respond to theories which claim to provide a short cut to identifying the readiness of individuals.
2. In the desire to ensure that teaching becomes a profession, there is need for it to become research based. Thus, teachers and teacher educators are prone to grasp at any theory which claims to provide a body of well established research which can underpin teaching and provide it with a scientific base. Proponents

of brain based learning, learning styles and the like offer to provide this though, as I have argued, they have failed to deliver.

3. There is a strong drive from administrators and governments to deflect concern about educational failure from social causes to schools. It is established beyond any doubt that educational success and failure is due largely to social background. Children come to school privileged or deprived and this has a lasting effect on their progress. So called “good” schools are attended by privileged: “bad” schools are attended by the deprived. In order to avoid the implications of this it is suggested teachers can fix it all up. Social class, ethnicity, and home background are pushed aside and the focus is on the learner as a depoliticised, non social entity.

Thus, the emphasis on learning styles and brain research, as well as other programmes favoured by state departments of education, are tactics to divert attention from the basic causes of school failure: poverty, poor housing, indifferent health and all that goes with these in the way of lack of books, time, space and freedom to pursue learning. Remedying these problems requires money and other resources which make enormous demands on the public purse. It is politically expedient to shift responsibility onto teachers and to label critics as “deficit theorists.”

## **Brain and Mind**

In this paper I have argued, among other things, that brain research has little to offer to education. At a conference such as this I feel I should go on to examine whether this is simply a matter of empirical fact (brain research has not to date revealed anything of significance for educational practice), or whether the problem is a deeper one. Could it be the case that while, mind is central to education, knowledge about the brain is **in principle** irrelevant?

There are those who argue that talk of minds cannot in principle be reduced to talk about brains. Brain language is concerned with neurons and their relationships in a system. Mind language is concerned with knowledge, actions and feelings. It would seem to follow that brain research, in principle, cannot have much to teach educators since education is centrally about understanding and meanings, about the formulation of concepts and the justification of theories. Thus, Andrew Davis argues that “we could never by-pass the language of belief, intention, reason and motive in the vain attempt to refer directly to brain functioning when interacting with others and interpreting their actions (2004, p. 24). He insists that in order to identify relevant brain states, we are obliged to refer to the relevant psychological phenomena, using the traditional terminology of beliefs, desire and intentions. Hence these, not brain states, are logically prior. On the other hand, Evers (1990) argues persuasively that brain research could have a beneficial effect on educational theory. Overall, I do not hold to the view that, in principle, brain research is irrelevant to understanding mind or education. What, then, do I think?

Firstly, I reject any form of dualism in which the brain is physical and the mind immaterial. This, in my view, requires some kind of spiritual soul, existing alongside of but different from the body (and able, on most accounts, to exist apart from the body, at least after death). I can make no sense of such an entity preferring Aristotle’s idea of soul as “the principle of life” and existing (if “existing” is the right word) only as informing a living system. In some important sense, the mind is in the brain though I believe it is not “just” in the brain. I reject the view of mind put forward by our colleague, Christine Hale (2006) at last year’s annual conference. I think that her view of mind is too mystical to be credible, despite the support she claims from biologists and other scientists. Moreover, her educational claims seem to me to rest on the same mistake as those who promote brain based learning. Just as empirical findings about the brain have little or no implications for teaching, so a view of mind that down plays the brain has little or no implications either. One can quite easily make points about the limitations of certain forms of education without having a non-

material theory about the mind. Indeed, theorists have advocated broader views of education, long before there was any talk about brain and its relationship to mind. It is true that science isn't everything but it is nevertheless very important for human advancement. By way of example, science, on its own cannot solve the environmental crisis (values, politics and human will are involved) but it will not be solved without it. Hale's account seems to me to go too far in dismissing scientific thinking.

Secondly, I think that knowledge about the brain can never be *sufficient* for educational practice. The reason is simple: we may learn much about learning to swim from examining the brain function of swimmers, but equally, one must understand much about the nature of water and the behaviour of human bodies in water. And this can be generalised to other forms of learning: to learn mathematics will involve brain waves of various sorts; it will also involve logical relationships within the discipline of mathematics and, arguably, reference to physical objects in the world.

Thus, as a kind of informal conclusion from these two points, I want to suggest that, even if the brain is ultimately important for education, classroom education is several steps removed from the scientific work on the brain. Progress in translating "folk psychology" into brain talk has not proceeded very fast and while the possibility cannot in principle be ruled out, it is unlikely to pay off for education in the near future. The language of education is firmly rooted in the language of beliefs, intentions and motives and is likely to be so for considerable time to time. I would argue, that the job of educational researchers is, as it were, to work from the educational end and not try to apply brain research prematurely.

One lead is provided by the work of my colleague and friend, the late Graham Nuthall. As a result of some forty years research in classrooms, and reflections on that research, he concluded that the learning that takes place in classrooms with living teachers is unique and irreplaceable. If we want to improve it we must understand it in its own terms. His posthumously published book *The Hidden Lives of Learners* (2007) points the way.

## **Conclusion**

There is a role for philosophers of education in warning teachers about the dangers of government demands, commercial interests and ideological propaganda. We need to reflect on the demands made on us by the tyranny of research grants, the demands of the PBRF and by our understandable desire to be seen to be 'relevant' and counted among the 'good guys'. The academic's role as "critic and conscience of society" is not served by uncritical acceptance of fashionable concepts which often serve ideological purposes.

Nevertheless, I do not want to end with this point. I want, rather, to reiterate a point that I made earlier on. I believe that a thorough research based understanding of human learning is absolutely necessary for advancement in education. It is unfortunate when educational philosophers seem to undermine such research with rather empty talk about positivism. I want education to be more scientific not less. This needs greater attention to well defined concepts and well conducted research, free as far as possible from political and commercial contamination. Thus, while decrying the pseudo-science of 'brain based learning', 'learning styles' and other common myths we should reaffirm our commitment to the importance of sound empirical research.

## **Notes**

1. Unless otherwise noted, all references are to Blakemore and Frith (2005).



## References

- Blakemore, S.J. & Frith, U. (2005) *The Learning Brain: Lessons for Education* (Malden, MA: Blackwell).
- Boyle, E., MacDonald, J., Aked, J., Main, D. & Dunleavy, K. Thinking Styles and Social Problem Solving, *Bridging Theory and Practice*, pp. 67-79.
- Bransford, J.D., Brown, A.L. & Cocking, R.R. (2000) *How People Learn: Brain, Mind, Experience and School* (Washington,DC: National Academy Press).
- Bridging Theory and Practice: Eighth Annual Learning Styles Conference*, University of Hull, June 30-July 2, 2000.
- Bruer, J.T. (1997) Education and the Brain: A Bridge too Far, *Educational Researcher*, 26:8, pp. 4-16.
- Cassidy, S. (2004) Learning Styles: an Overview of Theories, Models and Measures, *Educational Psychology*, 24:4, pp. 419-444.
- Charlesworth, Zarina M. The Influence of Culture on Learning Styles and Strategies, *Bridging Theory and Practice*, pp. 103-113.
- .Coffield, F, Moseley, D, Ecclestone, K., Hall, E. (2000) A Systematic Review of Learning Styles and Pedagogy in *Bridging Theory and Practice*, p. 115 (Abstract only)
- Coffield, F, Moseley, D., Hall, E. and Ecclestone, K. (2004a) *Should we be using learning styles?* (London: Learning and Skills Research Centre/ University of Newcastle upon Tyne).
- Coffield, F., Moseley, D., Hall, E. and Ecclestone K. (2004b) *Learning Styles and Pedagogy in post-16 Learning* (London: Learning and Skills Centre, University of Newcastle upon Tyne).
- Curry, L. (1990) A Critique of the Research on Learning Styles, *Educational Leadership*, 48:2, pp. 50-56.
- Davis, A. (2004) The Credentials of Brain-based Learning, *Journal of Philosophy of Education*, 38:1.
- Evers, C. (1990) Educating the Brain, *Educational Philosophy and Theory*, 22.2, pp. 65-80.
- Hale, C. (2006) A Problem: Teaching to Brain-based Mind in the Classroom, paper presented at annual conference PESA.
- Jensen, E. (2006) *Enriching the Brain: How to Maximise Every Learner's Potential* (San Francisco: Jossey-Bass).
- Mainemelis, C., Boyatsis, R., and Kolb, D. (2002) Learning Styles and Adaptive Flexibility: Testing Experiential Learning Theory, *Management Learning*, 33:1, pp. 5-33.
- Nuthall, G. (2007) *The Hidden Lives of Learners* (Wellington: NZCER).
- Shore, R. (1997) *Re-thinking the Brain: New Insights into Early Development* (New York: Families and Work Institute).
- Slavkin, M.L. (2004) *Authentic Learning: How Learning about the Brain can Shape the Development of Students* (Lanham, Md: Scarecrow Education).
- Smith, W., Sekar, S. and Townsend, K. (2002) The Impact of Surface and Reflective Teaching and Learning on Student Academic Success, in: Valcke, M. and Gombeir, D. (eds.), *Learning Styles: Reliability and Validity: Proceedings of the 7<sup>th</sup> Annual Learning Styles Conference*, pp 407-418.