Learning theories across the twentieth century: Public context and private images

Miles Barker

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Miles Barker
School of Education
University of Waikato

Introduction

In volume 3 of *Teachers and Curriculum* Fred Biddulph and Ken Carr described and contrasted five major learning theories: behaviourist, developmental, humanist, social constructivist and enactivist (Biddulph and Carr, 1999). Their purpose was to provide a mental framework against which teachers can compare their own (often unconscious) beliefs about learning, and also to help teachers identify the (often implicit) learning theories which underpin curriculum documents.

My article should be read with Fred's and Ken's figure 1 (their outline of the five theories) in mind. I shall not describe these theories any further; instead, in end-of-century mode, I shall place them in a historical perspective. The first part of my article considers each of the five theories in the very wide **public context** of the unfolding history of the twentieth century: How and when did each theory originate? Has it co-existed with other learning theories? How have its fortunes waxed and waned? How much influence does it currently exert? The second part of the article is a much more personal history: I describe four **private images** for classroom teaching and learning which I believe I held in the last four decades of the century, and I analyse them in terms of the five learning theories.

Learning Theories: The Public Context

Where have our classroom learning theories come from? Learning theories have often been self-generating: they coalesce, they diverge, and they replace each other.

However, it is important to acknowledge that learning theories have often ultimately arisen in complex ways from fields *quite remote* from classrooms and education systems. How this comes about is often related to the method which we choose to look for evidence of learning in classrooms: we may decide to observe children's behaviours; to analyse their classroom conversations; to interview them before, during or after learning; or even to record physiological and neural changes. Each of these methodologies may draw on expertise very remote from teachers' own experience: from behavioural psychology, linguistic theory, cognitive psychology, or medical practice, respectively.

This proneness to outside methods should not cause us to conclude that the whole area of learning theory is in some unique way weak or unselfreliant. (The writing of history, it should be remembered, has also been similarly enriched by methodologies from sociology, statistics and literary theory.) Instead, we need to accept that it is totally proper that learning theories resonate with disciplines as seemingly remote from the classroom as economics, philosophy, psychotherapy, and medical science. Failure of this feedback process would result in two dire consequences: our education systems would be fatally isolated and irrelevant for living in the world at large; and educators would have cut themselves off from sources of inspiration and new ideas. However, the connections between established methods in education and those in other fields are often complex, and occasionally
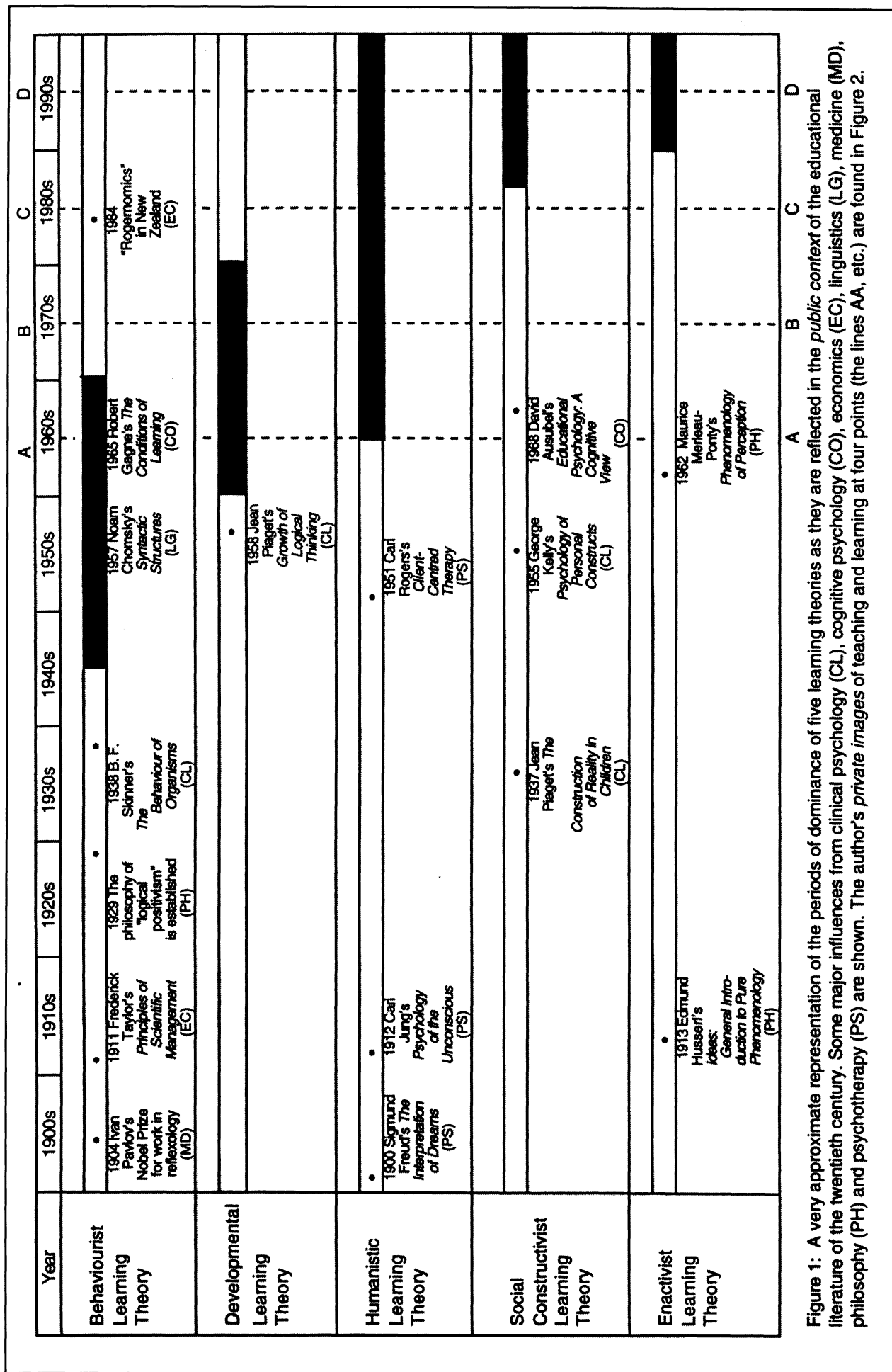
Figure 1: A very approximate representation of the periods of dominance of five learning theories as they are reflected in the *public context* of the educational literature of the twentieth century. Some major influences from clinical psychology (CL), cognitive psychology (CO), economics (EC), linguistics (LG), medicine (MD), philosophy (PH) and psychotherapy (PS) are shown. The author's *private images* of teaching and learning at four points (the lines AA, etc.) are found in Figure 2.

Year	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s
Behaviourist Learning Theory	1904 Ivan Pavlov's Nobel Prize for work in reflexology (MD)	1911 Frederick Taylor's Principles of Scientific Management (EC)	1929 The philosophy of "logical positivism" is established (PH)	1938 B.F. Skinner's The Behaviour of Organisms (CL)		1957 Noam Chomsky's Syntactic Structures (LG)	1965 Robert Gagne's The Conditions of Learning (CO)		1984 "Rogernomics" in New Zealand (EC)	
Developmental Learning Theory						1958 Jean Piaget's Growth of Logical Thinking (CL)				
Humanistic Learning Theory	1900 Sigmund Freud's The Interpretation of Dreams (PS)	1912 Carl Jung's Psychology of the Unconscious (PS)				1951 Carl Rogers's Client-Centred Therapy (PS)				
Social Constructivist Learning Theory				1937 Jean Piaget's The Construction of Reality in Children (CL)		1955 George Kelly's Psychology of Personal Constructs (CL)	1968 David Ausubel's Educational Psychology: A Cognitive View (CO)			
Enactivist Learning Theory		1913 Edmund Husserl's Ideas: General Introduction to Pure Phenomenology (PH)					1962 Maurice Merleau-Ponty's Phenomenology of Perception (PH)			

controversial: educators apply labels like 'positivist' or 'interpretivist' or 'critical' (Robottom and Hart, 1993) to justify their own favoured methodology which they have adapted from other fields, or to distance themselves from methodologies favoured by others.

What follows, summarised in Figure 1, is no more than an overview of the lifespans of the five human learning theories as they are reflected in the educational literature, and a description of their links to some other major influences in the twentieth century. (The lifespan attributed to each theory is, of course, only a very rough guide: its most enthusiastic proponents would probably want an earlier start-date, and would argue for a longer shelf-life.) To sum up: the purpose is not to propose simplistic or mono-causal explanations for the origins or popularity of particular learning theories. Instead, it is to further Fred's and Ken's purpose: providing sketches of the global, historical background of learning theories to hopefully illuminate the way we carry out our teaching lives, day by day.

The Five Learning Theories: Origins, Fortunes, Falls from Grace

Behaviourist learning theory
B. F. Skinner published his classic text *The Behaviour of Organisms*, which introduced the principles of operant conditioning and learning through re-inforcement, in 1938. However, behaviourism did not achieve substantial educational recognition until a conference in Indiana in 1946 (Simmons, 1996 : 460). By this time, coalescing developments since the turn of the century in medicine, economics and philosophy had all proved persuasive: Ivan Pavlov (1849-1936), who won his Nobel Prize in 1904, had always considered that the body is like a machine, with its own regulatory mechanisms, and he regarded animals as experimental substitutes for human beings

(Sparks, 1982 : 148). Again, Frederick Taylor's (1856-1915) influential book *Principles of Scientific Management* (1911), with its narrow physiological focus on work-place efficiency and 'man-as-machine' (Hoy and Miskel, 1978 : 4; Luke, 1999) was later seen as a justification for those behaviourist educators who would employ stopwatches to research teacher 'wait time' or pupil 'on-task' efficiency. And in Europe, especially Vienna, the 'logical positivist' movement in philosophy (first labelled as such in 1929) was seeking a modernist, progressive, anti-metaphysical approach after the chaos of World War 1. In fact, the basis of their new belief - that only statements which are observationally (science) and logically (mathematics) verifiable are meaningful - was to be most long-lived not in Europe but in Skinner's U.S.A., where many of the positivists emigrated prior to World War 2 (Holton, 1993 : 15-41).

Skinner's focus on behaviour which operated on the environment was further boosted by post-war repugnance at the genetically-based racial doctrines of the nazis (Steen, 1996 : 44). However, critics also became vocal. In 1957 Noam Chomsky's *Syntactic Structures* proposed that our ability to communicate through language is rooted in the brain's basic wiring (this opposed Skinner's accounting for language in terms of simple stimulus-response and reinforcement) and a ground-swell of other, related criticisms (like that of Carl Rogers, see below) saw the influence of behaviourism beginning to wane by the late 1960s (Duit and Treagust, 1998 : 4). In a couple of related forms, however, behaviourism has lived on. Robert Gagne's learning hierarchies had some appeal in the 1970s because they *were* cognitively-based (Lefrancois, 1997 : 190), but dissatisfaction emerged with the lack of evidence for their validation (Driver, 1982). Also, in New Zealand since the mid-1980s, and elsewhere, so-called New Right economic policies in education

(Snook, 1997) have stimulated what Neyland (1995) has labelled a 'neo-behaviourist' approach to teaching.

Developmental learning theory
The generation of this theory is basically the story of Jean Piaget's (1896-1980) intellectual pathway from the 1920s to the 1950s. Over that time, which Piaget spent mainly in Zurich and Geneva, he knew or was influenced by Carl Jung, Sigmund Freud, Alfred Binet and Albert Einstein. Piaget's unique combination of biological thought, the interview methods he adopted from clinical psychology, and his interest in Kant's ideas about knowledge, culminated in his publishing a full form of the 'stage theory' in *The Growth of Logical Thinking* in 1958. Jerome Bruner, attending a conference in 1959 at Woods Hole, Massachusetts, where Piaget's ideas were being aired, was enthusiastic about what he saw as the potential in the stage theory, and the next year Bruner's *The Process of Education* effectively launched the stage theory in America. Bruner's excitement as he explored the notions of 'readiness for learning' and 'the spiral curriculum' was obvious: "we begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development" (Bruner, 1960 : 33).

These possibilities were to captivate educators, especially in the U.S.A., for the next twenty years. However by the late 1970s the hoped-for breakthroughs had not occurred. Piaget's personal focus was always on the underlying structure of cognition - on development, not learning - and he was not really interested in problems related to the teaching and learning of subject matter. The possibility that context and personal experience might be more significant than a child's developmental stage was raised (Donaldson, 1978) and the actual existence of universal, context-independent mental stages was beginning to be questioned (Driver, 1978). However, since

around 1980 some interest has continued to be shown in the possibility that a modified stage theory can accelerate the growth of logical thinking, e.g. Shayer and Adey (1992).

Humanistic learning theory

The principle that how people feel affects how they learn has not always been self-evident. We owe the discovery of the unconscious, and the extent to which it influences not only our thinking but the very way we live our lives, to Sigmund Freud (1856-1939). Our non-waking hours can provide clues to this process: the theme of his book *The Interpretation of Dreams* (1900) is encapsulated in fellow psychotherapist Carl Jung's (1875-1961) view that dreams are "the royal road to the unconscious". But like the unconscious itself, attention to the emotions in theories of learning has often been subterrranean. Skinner avoided reference to *all* mental states, emotional as well as rational, and even Piaget had little taste for discussing the emotions (Simmons, 1996 : 358). The slow shift in focus from one-to-one counselling through to a broader school-based concern with a personal growth which includes emotional growth is epitomised in two books by Carl Rogers (1902-1987): *Client-Centred Therapy - Its Current Practice, Implications and Theory* (1951) and *Freedom to Learn* (1969). The humanist philosophy, which precipitated a spectacular debate between Skinner and Rogers in 1956 (Rogers, 1980 : 55), was emerging as a theory of learning in schools by the mid-1960s. The heading of one of Rogers's (1969) chapters, "The Goal: The Fully Functioning Person", has summed up the theory's appeal for numerous aspects of New Zealand's educational scene over the last thirty years: guidance counselling, health education, taha Maaori, environmental education, and so on. Nevertheless, as Biddulph (1997) points out, there has never been a single coherent and consistent learning theory constructed around humanism, and this possibly explains why its influence has been diffuse.

Social constructivist learning theory

Although it can be argued that constructivism is as old as the teaching methods of Socrates (Hawkins, 1992), its twentieth century origins can clearly be traced through Piaget's book *The Construction of Reality in Children* (1937) in which Piaget described how people adapt their thinking to include new ideas as new experiences provide additional information. Adaptation comprises assimilation, the incorporation of new information into current mental schema, and accommodation, the way the intellectual organisation has to adjust to the new information. However, by the end of the 1970s books such as David Ausubel's *Educational Psychology: A Cognitive View* (1968) were pushing Piaget's notion of adaptation in new 'constructivist' directions. Both Piagetians and constructivists emphasised the importance of prior knowledge, which they saw as relatively well structured and stable, but the Ausubel influence was promoting an 'alternative conceptions' field of research in which constructivists focussed on knowledge in the content domain being taught to children in school, rather than on children's underlying, universal operational thinking. Constructivists were also more committed than the Piagetians to bringing about changes in children's mental structures: contrasts were drawn between scientists' and children's propositions about the world, and conceptual change with a strong cognitive rather than affective emphasis was pursued. The fact that conceptual change was initially seen as a **personal** matter can be attributed in part to the influence of George Kelly's influential *Psychology of Personal Constructs* (1955).

By the late 1980s, Jean Lave, Lev Vygotsky, Jerome Bruner (whose stance has evolved considerably over the years) and others were suggesting that learning should be thought of less as an individual activity, and more as the product of complex socio-cultural processes. This latter notion of **social** constructivism, with its emphasis on social interactions and collaborative learning environments has flourished in the 1990s. However, some have criticised its assumptions about Western norms of rationality, its perceived relativism, and its failure to portray the fluidity of learners' cognitive processing and the lack of stability of their ideas.

Enactivist learning theory

This question of the fluidity of the mind and its cognitive structures touches on a point of departure between constructivism and enactivist learning theory, propounded in Canada, especially, since 1990, and between constructivism and the related area of phenomenography, developed particularly in Gothenburg, Sweden, since the early 1980s, e.g. Marton and Booth (1997). Proponents of these new ideas actually reject the whole constructivist assumption of a world-person dualism, that is, they reject the distinguishing of an independent, external world from an internal world of mental models, propositions and categories of ideas (in the case of personal constructivism) or of inner representations of the social relationships of the external world (in the case of social constructivism). The basis for this can be traced back to the philosophy of Edmund Husserl (1859-1938), the founder of phenomenology, who declared, "I exist, and all that is not-I is mere phenomenon dissolving into phenomenal connections" (quoted in Magee 1998 : 211), and developed further in Maurice Merleau-Ponty's (1908-1961) view of the self as a dynamic and fluid structure that is constantly changing and that is always reconfiguring itself (Davis, Sumara and Kieren, 1996).
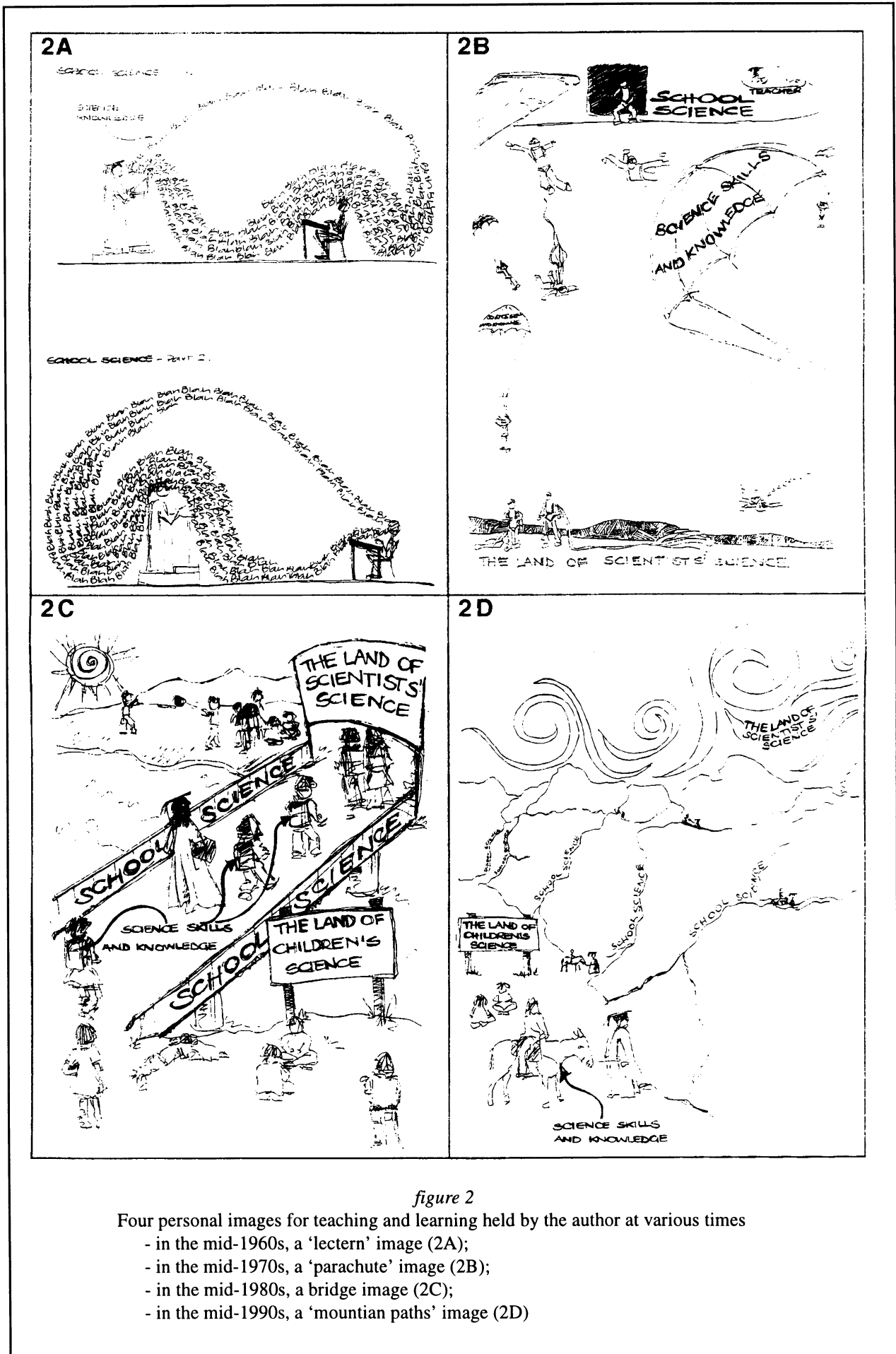
figure 2

Four personal images for teaching and learning held by the author at various times
- in the mid-1960s, a 'lectern' image (2A);
- in the mid-1970s, a 'parachute' image (2B);
- in the mid-1980s, a bridge image (2C);
- in the mid-1990s, a 'mountian paths' image (2D)

Learning Theories: Private Images

Our private images of teaching and learning - the working models which are formed by, and give shape to, our day by day classroom work - are doubtless influenced by many more factors than the received wisdom of whatever learning theories are in place in the public context of the time. These factors might include: our own intuition and personality, the current curriculum documents, how we feel about ourselves and our students, the special character of the school, and so on. In this section, I switch into autobiographical mode as I remember the successive images I have held over more than thirty years of teaching, and I hold them up against the theories of learning which were apparently flourishing in the world at the time. I say "apparently" because, for the first twenty years, when I was secondary school teaching, I was very little aware of what theories *were* dominating the world at large. So now I embark on an exercise somewhat similar to answering the question,"Where were you on the day JFK was assassinated (or Norman Kirk died)?"

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The nineteen sixties

When I began secondary school science teaching in 1965 I believe I held a 'lectern' image of teaching and learning (Fig. 2A). Officially, I may have come up with something more fancy, but my actual behaviours (note!), as I recall them, resonated with this private image. I kept six exercise books, one for '7Bio', one for '3 Science', one for '6 Chem', and so on, and I would

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write out THE NOTES the night before. This wasn't a small part of my lesson preparation - this basically <u>was</u> my lesson preparation. Practical work, inspired by the 1963 'yellow version' of the Biological Sciences Curriculum Study (BSCS), was of the 'discovery' type which, like THE NOTES, was designed hopefully to entrap students into producing encouraging outputs at exam time.

Knowing, as I do now, that the educational world at large at that time (Fig. 1, line AA) was still mainly in the grip of behaviourist learning theory softens and excuses somewhat (at least in my own eyes) this austere picture. And, of course, I cannot help but note the long shadow which behaviourism has cast, and I wonder at the amazing resilience of the 'lectern' model, in which teaching is telling and learning is remembering and assessment is regurgitation.

The nineteen seventies

By the mid-1970s my private image had shifted substantially. My 'parachute' image (Fig. 2B), visualised in terms of groups of learners rather than solitary individuals, has a clear sense of direction about it. School science is now a conscious preparation, a process of pre-adaptation, and skills (as well as knowledge) are an important part of the parachute survival package which the pilot/ teacher provides the scientists-to-be/ pupils. This 'parachute' model has me, the teacher, firmly in the driver's seat, and the school science aeroplane flies on, apparently

powerless to offer any solace for the many pupils whose conceptual parachutes fail to open.

By hindsight, I can detect the influence (although sometimes shadowy) of three major learning theories of these times (Fig. 1, line BB). Behaviourism, by now out of fashion in much of the educational literature, must have been still very evident in practice: the *Science: Forms One to Four Draft Syllabus and Guide* of 1978 has the ringing challenge on nearly every page: "At the end of this section, a student should be able to...". And humanist influences may well have fuelled my concern at the large numbers of students whose metaphorical parachutes failed to open. Piaget's general interest in the development of intellectual skills comes through in the 'parachute' model, but it was the specifics of the stage theory - which I encountered on an inservice course on the Australian Science Education Project (ASEP) - which made a huge, if tantalising and elusive, impact on me. The statement in the ASEP Handbook, page 5, that "if the new experience does not fit the child's established mental structure, then the structure should be modified, or new ones built" seemed to hold out so much

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promise of a rational, systematic approach to the learning problem. Sadly, no-one was ever able to show me how to actually match content-based classroom learning experiences with children's established cognitive stages.

The nineteen eighties

My 'bridge' image (Fig. 2C) contains a crucial new feature: 'The Land of Children's Science'. Now,

conceptually, students from the outset have a secure place to stand, and the role of the teacher is consequently very different from that in the 'parachute' model, namely, to intervene sensitively and when appropriate, encouraging and accompany learners on a journey towards understandings which are more consistent with those which scientists hold. My own path towards this image was triggered by a suggestion from University of Waikato science educator Roger Osborne that I read a landmark paper by British educator Rosalind Driver. That paper (Driver, 1982), which contained a decisive critique of both the Piagetian stage theory and the Gagne version of behaviourism, was also an introduction to the importance of children's prior content knowledge in learning. It reinvigorated my love of children's learning, a love which has never left me.

By this time (Fig. 1, line CC) I was teaching in tertiary education, and innovations in learning theories now resonated with my day to day practice, rather than illuminating it by hindsight. My 'bridge' image, with its numerous participants, probably reflected a social constructivist position rather than a personal constructivist one. In fact, the difference is highlighted by an earlier 'bridge' image (Fig. 3) which Roger Osborne devised about 1983: both in its cultural connotations, and in its focus on an individual wrestling with a clear dichotomy of knowledge choices, it reflects a quite pure form of personal constructivism. But 'bridge' images provoke good questions: Who builds the bridge? When, and where? Why is there only one bridge? Can you go half way over the bridge? Can and should people return over the bridge?

The nineteen nineties

My current 'mountain paths' image (Fig. 2D) presents learners with multiple, branching learning routes, and it addresses an enormous concern I had had since the 'parachute' image: the inappropriateness of regarding all

figure 3
A personal image for teaching and learning held by
Roger Osborne about 1983
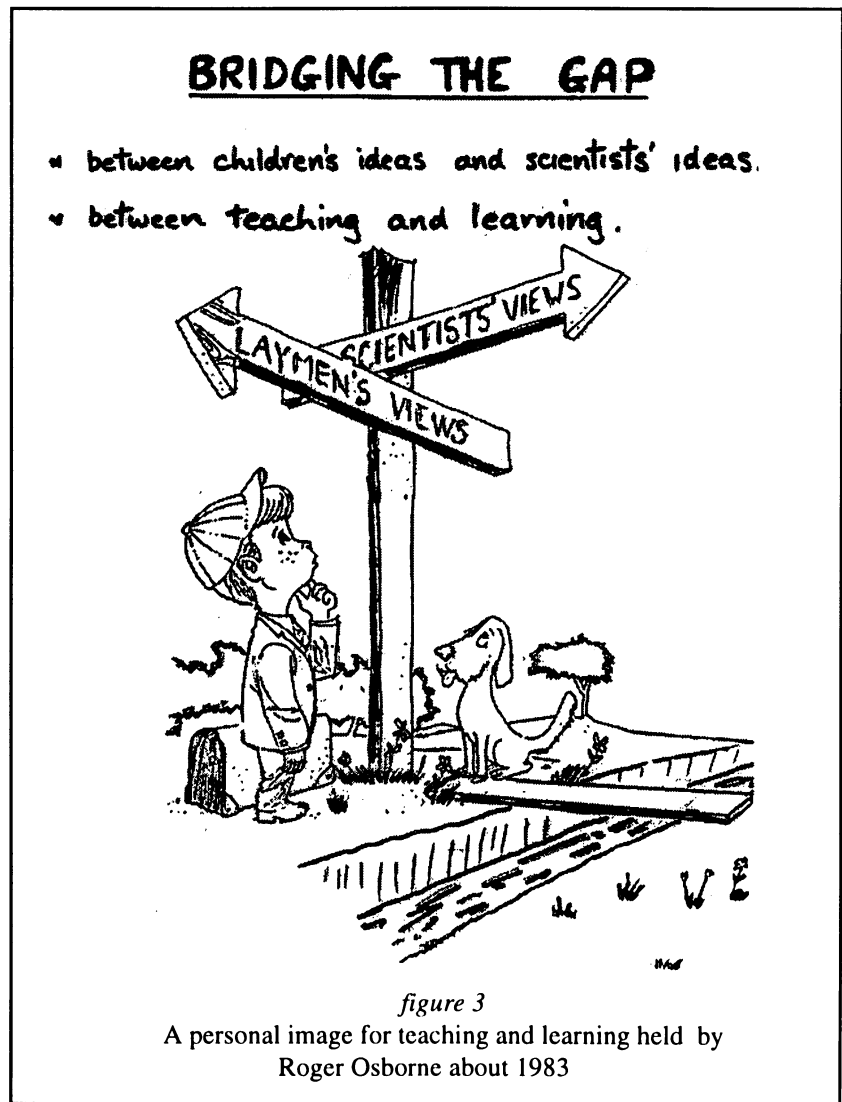
students as 'scientists-to-be'. The importance of providing meaningful science for *all* students (Fensham, 1986) is represented in the 'mountain paths' image by the salubrious upland meadows which will be as far as most students will wish to venture. Only those who are inspired to push professional science to its limits will take paths higher, to the austere Einsteinian peaks, and their teachers will have to remember that climbers need to be specially prepared before they venture into the rarified air of the Himalayan 'death zone'.

My mid-nineties model (Fig. 1, line DD) is still basically social constructivist, insofar as it takes account of students' diverse skills and knowledge. However, at the same time, it also tries to reflect my growing concern, as the decade progressed, with the need to address

ontological questions in classrooms. What is the nature of the pathway itself? How is reality represented in the lowlands of children's science and how do the "rules of the game" (Carr *et al.*, 1994) change as the path penetrates further towards the abstract, theoretical world of scientists' models and laws? More generally, how can teachers reflect and develop appropriate views about the claims and limits of knowledge in the various learning areas of the curriculum framework?

Concluding Remarks

What should I attend to in the future? I am interested, for example, in enactivist learning theory but I do not understand it well enough yet, and I am cautious because I am unclear what specific messages it has for me in my classroom. How do

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I know what constitutes the latest fad, and what is a significant breakthrough? As Guy Claxton points out, searching for the ideal learning theory is elusive because the domain of learning is so big that there are not just different theories around, but different *kinds* of theories (Claxton, 1984 : 8). It may be, for example, that neurology, long thought of as being an unpromising avenue, will move to centre stage - exciting work seems to be opening up in the areas of artificial intelligence and neural selection (Sacks, 1995) - and learning theory, as in the days of Pavlov, might again be described largely in the language of medicine. Whatever direction learning theories take in the next century, it seems that we in teaching will continue to be doubly challenged: to entertain input from the public context far beyond our classrooms, but yet to somehow make sense of it all in terms of our own private images.

References

Biddulph, Fred (1997). Humanistic Learning Theory. In B. Barbour *et al.* (Eds.). *SAME papers 1997.* Hamilton: Centre for Science, Mathematics and Technology Education Research, University of Waikato, 31-39.

Biddulph, Fred and Carr, Ken (1999). Learning Theories and Curriculum. *Teachers and Curriculum,* 3 (in press).

Bruner, Jerome S. (1960). *The Process of Education.* Cambridge MA: Harvard University Press.

Carr, M., Barker, M., Bell, B., Biddulph, F., Jones, A., Kirkwood, V., Pearson, J. and Symington, D. (1994). The Constructivist Paradigm and Some Implications for Science Content and Pedagogy. In P. Fensham, R. Gunstone and R. White (Eds.). *The Content of Science: A Constructivist Approach to its Teaching and Learning.* London: The Falmer Press, 147-160.

Claxton, Guy (1984). *Live and Learn: An Introduction to the Psychology of Growth and Change in Everyday Life.* London: Harper and Row.

Davis, A. B., Sumara, D. J. and Kieren, T. E. (1996). Cognition, Co-emergence and Curriculum. *Journal of Curriculum Studies,* 28(2), 151-169.

Donaldson, M. (1978). *Children's Minds.* Glasgow: Fontana.

Driver, R. H. (1978). When is a Stage not a Stage? *Educational Research,* 21(1), 54-61.

Driver, R. H. (1982). Children's Learning in Science. *Educational Analysis,* 4(2), 69-79.

Duit, Reinders and Treagust, David (1998). Learning in Science - From Behaviourism Towards Social Constructivism and Beyond. In B. Fraser and K. Tobin (Eds.). *International Handbook of Science Education.* Dortrecht: Kluwer Academic Publishers, 3-25.

Fensham, P. (1986). Science for All. *Educational Leadership,* 44, 18-23.

Hawkins, David (1992). Constructivism - Some History. In P. Fensham, R. Gunstone and R. White (Eds.). *The Content of Science: A Constructivist Approach to its Teaching and Learning.* London: The Falmer Press, 9-13.

Holton, Gerald (1993). *Science and Anti-science.* Cambridge MA: Harvard University Press.

Hoy, W. K. and Miskel, C. G. (1978). *Educational Administration: Theory, Research and Practice.* New York: Random House.

Lefrancois, Guy (1997). *Psychology for Teaching (9th ed.).* Belmont CA: Wadsworth.

Luke, Allan (1999). Keynote Address: The Jig is Up: An Alternative History of Psychology or why Current Concepts of Identity and Development are Part of the Problem Rather than Part of the Solution. Proceedings of the Conference of the New Zealand Association of Counsellors (NZAC), Hamilton, June 25-28, 26-34.

Magee, Bryan (1998). *The Story of Philosophy.* London: Dorling Kindersley.

Marton, Ference and Booth, Shirley (1997). *Learning and Awareness.* Mahwah NJ: L. Erlbaum Associates.

Neyland, Jim (1995). Neo-behaviourism and Social Constructivism in Mathematics Education. In A. Jones *et al.* (Eds.). *SAMEpapers 1995.* Hamilton: Centre for Science, Mathematics and Technology Education Research, University of Waikato, 114-143.

Robottom, Ian and Hart, Paul (1993). *Research on Environmental Education - Engaging the Debate.* Geelong: Deakin University Press.

Rogers, Carl (1980). *A Way of Being.* Boston: Houghton Mifflin Company.

Sacks, Oliver (1995). A New Vision of Mind. In John Cornwall (Ed.). *Nature's Imagination: The Frontiers of Scientific Vision.* Oxford: Oxford University Press, 101-121.

Shayer, M. and Adey, P. (1992). Accelerating the Development of Formal Thinking in Middle and High School Students 3: Testing the Permanency of Effects. *Journal of Research in Science Teaching,* 29, 1101-1115.

Simmons, John (1996). *Scientists: The Hundred Greatest Minds of All Time.* Sydney: The Book Company.

Snook, Ivan (1997). Democracy, Education and the New Right. In Mark Olssen and Kay Matthews (Eds.). *Education Policy in New Zealand: The 1990s and Beyond.* Palmerston North: The Dunmore Press, 358-371.

Sparks, J. (1982). *The Discovery of Animal Behaviour.* London: Collins.

Steen, R. Grant (1996). *DNA and Destiny - Nature and Nurture in Human Behaviour.* New York: Plenum Press.