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The origins of competency-based training

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This article attempts to trace the origins of competency-based training (CBT), the theory of vocational education that underpins the National Training Framework in Australia. A distinction is made between societal and theoretical origins. This paper argues that CBT has its societal origins in the United States of America during the 1950s, 60s and 70s. Public debate and government initiatives centred on the widely held view that there was a problem with the quality of education in the United States. One of the responses to this crisis was the Performance-Based Teacher Education movement which synthesised the theory of education that became CBT. The theoretical origins of CBT derive principally from behaviourism and systems theory – two broad theoretical orientations that influenced educational debate in the United States during the formative period of CBT. Most of the component parts of CBT were contributed by specialists with a background in one or both of these theoretical orientations.

Introduction

The Australian National Training Framework – the government-endorsed national system of vocational education and training (VET) – rests on the principles of competency-based training (CBT). However, contemporary practitioners within Australia's VET system are often only vaguely aware that CBT was once a hotly contested issue. Furthermore, training practitioners often do not know the societal and theoretical origins of CBT. But these origins are not necessarily of mere historical interest. Although CBT appears to be something of a 'given' in the Australian VET scene, it remains an essentially volatile system set within a dynamic context. As the needs of VET stakeholders change and as research and practice in VET reveal new problems and possibilities, CBT will change and potentially transform. When this occurs the 'genetics' of CBT will play a part in the shape it eventually takes.

However, at this stage there are few resources for researchers on the history of CBT. In the clamorous rush to implement CBT, there has been little effort to chronicle the genesis of the movement. A few pages can be found in synoptic works by authors such as Houston (1974), Norton, Harrington and Gill (1978), Tuxworth (1989) and Harris, Guthrie, Hobart and Lundberg (1995), but these accounts are mostly sketches designed to contextualise substantial treatments of problems of interpretation and implementation. The present article represents an attempt to amplify and structure the accounts found in these and other texts in order to trace the genetics of CBT. Content analysis was applied to a body of texts from the 1950s, 60s and 70s to confirm the indications supplied by Tuxworth (1989) and Harris *et al.* (1995) regarding the early phase of CBT development and to guide the articulation of the discussion.

The following discussion is structured by a distinction between *societal* and *theoretical* origins of CBT. This distinction is introduced because a treatment of the theoretical underpinnings alone would

not account for the synthetic unity displayed by the system of CBT. There is no single theoretical principle that serves to integrate the various aspects of CBT. However, an understanding of the political and social forces at work in the formation of CBT helps to explain the juxtaposition of theoretical elements that characterises the CBT system in use today. The metaphor of genetics applies most obviously to theoretical origins in that it is the theoretical components of CBT that manifest in the contemporary Australian VET system. Yet it should not be forgotten that CBT is an amalgam of separate theoretical components alloyed in the crucible of powerful political forces, and that responsiveness to social and cultural pressures remains a significant feature of CBT.

It should be noted here that, although the term covering the educational systems based on competencies in Australia today is 'CBT', a number of different terms for the same or similar developments have emerged. Thus phrases that include 'Performance-Based Teacher Education' (PBTE), 'Competency-Based Teacher Education', 'Competency-Based Education and Training', 'Competency-Based Vocational Education' and 'Competency-Based Education' feature in the literature. The original terms will be retained in the present discussion, however, because they are employed by the original writers, and because there is no denying the fact that CBT is a nuanced movement. Perhaps the only barrier to regarding the alternate terms as equivalent is that some controversy surrounded the choice of 'performance-based' or 'competency-based' in characterising the teacher education movement of the 1970s. As Norton, Harrington and Gill (1978) explain, preference for the term 'performance' indicated an emphasis on skills, while critics of the term believed that professional knowledge was undervalued by 'performance' and opted for 'competency' as the more appropriate name. However, following the suggestions of Norton, Harrington and Gill and other commentators such as Tuxworth (1989), the two terms will be treated here as equivalent.

Societal origins of competency-based training

That the history of CBT has its political and social determinants is acknowledged by a number of commentators. An early critic of the movement, educational philosopher Broudy (1972: iv), believed that PBTE was a response to 'social pressures' and 'an attempt to cope with certain societal conditions' rather than being the outcome of purely scientific facts and principles. However, Broudy's appraisal of PBTE is not native to a critical stance. On the contrary, the early advocate of competency based education, Houston (1974: 5–6), suggested that it evolved as part of a 'culturally based movement', citing factors such as the broad trend in American society towards 'accountability' and 'personalisation'.

To gain a useful picture of the societal origins of CBT it will be sufficient to focus on the United States in the 1950s, 60s and 70s. This is not to say that nothing of consequence occurs before or after this period or outside America, but that simply the political catalyst of the movement was the American reaction to perceptions about Soviet Union technological progress that came to a head in the launch of Sputnik, and that the main outlines of CBT are established there by the end of the 1970s.

A range of commentators agree that Sputnik created the impetus for the changes that lead to the development of CBT (for example, Norton, Harrington & Gill 1978, Britell 1980, Harris *et al.* 1995). On October 4, 1957, the Soviet Union succeeded in placing the first artificial satellite called 'Sputnik I' into orbit around the earth. The impact of the Sputnik launch on the American psyche was significant. At that time, the Americans were busy with their own satellite project, and were confident that the glory of being the first in space would be theirs. The successful launch by the Soviets caught America by surprise and wounded their pride. As Harris *et al.* report, the immediate reaction of the United States was to 'undertake some deep soul searching with respect to its education and training system'

(1995: 37). After all, if Soviet Union technology was more advanced than America's, then the very foundation upon which American technological superiority was supposed to rest – its education system – was obviously the source of the problem. This general estimation of the effect of Sputnik on United States educational debate is widely held (e.g. Grouws & Cebulla 2000, Foster 1997, Elam 1971).

According to Elam (1971: 2), Sputnik served to legitimise and operationalise a federal role in education. The first official step in this process occurred in 1958 when the United States Congress passed the National Defence Education Act. The purpose of this act was stated in the Findings and Declaration of Policy section:

> The Congress hereby finds and declares that the security of the Nation requires the fullest development of the mental resources and technical skills of its young men and women. The present emergency demands that additional and more adequate educational opportunities be made available. The defence of this Nation depends upon the mastery of modern techniques developed from complex scientific principles. It depends as well upon the discovery and development of new principles, new techniques, and new knowledge. We must increase our efforts to identify and educate more of the talent of our nation.

With this Act began two decades of vigorous Federal intervention in education and training. According to Harris *et al.* (1995: 37) 'Large sums of money, in the late 1950s and throughout the 1960s and 1970s were directed towards curricular development in the sciences and vocational education programs. This gave economic support to the development of CBT'.

Norton *et al.* (1978) point to another important stimulus to the development of CBT that arose in the early 1960s. They describe how disquiet about dropout rates from secondary schools and difficulties experienced by graduates in securing and maintaining employment in the early 1960s lead to the constitution by President Kennedy of a

national panel to review vocational programs and legislation (1978: 8). As a result of the report produced by this panel, the Vocational Education Act of 1963 was enacted, which altered conceptions of work and funded the development of vocational education institutions. According to Norton *et al.* (1978: 8), this legislation lead to an unprecedented growth in vocational education and increased the demand for more and better prepared teachers.

Meanwhile, in the public debate about the crisis in education in the United States, attention turned to the quality of teacher preparation. Writers such as Conant (1963) and Korner (1963) criticised existing teacher education programs on the grounds that they were not based on actual work requirements, that instruction was not tailored to individual requirements, and that outcomes were not being evaluated (Norton *et al.* 1978: 8). Norton *et al.* (1978) describe how the United States government responded to these criticisms in 1965 with the Elementary and Secondary Education Act. Among other objectives, this legislation promoted research into the improvement of teacher education programs.

Facilitated by the Elementary and Secondary Education Act, a decisive event in the evolution of CBT occurred in 1968 when the United States Office of Education's (USOE) National Centre for Educational Research called for tenders to develop 'Comprehensive Elementary Teacher Education Models'. Norton *et al.* (1978: 8) note that the request for tenders specified that the models needed to include the use of behavioural objectives and systems analysis. According to Swancheck and Campbell (1981, in Tuxworth 1989: 11), the models produced by the ten institutions that won the tenders were characterised by 'the precise specification of competencies or behaviours to be learned, the modularisation of instruction, evaluation and feedback, personalisation, and field experience'.

Two issues in the public debate in the United States at the end of the 1960s also had an impact on the development of CBT. In his account

of competency-based education as a 'cultural movement', Houston (1974) identified the significance of both the 'personalisation' movement and the 'accountability' movement. He cited the work of Toffler (1970 in Houston, 1974: 6–7) who observed a major shift towards transience and uniformity in American society, signalled by such phenomena as disposable consumer goods, the regularity with which families in the United States moved house, depersonalisation of violence and job specialisation. Against this tide, Houston suggests that a deep-rooted American desire for 'individualised and personalised treatment' was making itself felt, particularly in 'youth culture' (1974: 7). Norton *et al.* (1978) also affirmed the influence of the personalisation movement, suggesting that it had its roots in student radicalism in university campuses. They claimed that students made the demand for instruction that was relevant to individual needs rather than the needs of a 'mythical majority' (p. 9).

Houston (1974) believed the emphasis on accountability – the common expectation that professionals will be knowledgeable in their fields and employ that knowledge successfully in practice – was given an effective contemporary form by the appearance of new and more accurate measuring tools (1974: 5–6). He sees the drive to accountability as having its source in the commercial and industrial sector of society. Norton *et al.* (1978) reinforced Houston's emphasis on the accountability movement as a factor in the evolution of CBT. They suggested that the educational commentator Lessinger instigated and lead the accountability movement through his book, *Every kid a winner: accountability in education* (1970). According to Norton *et al.* (1978: 9), this book aroused interest in measuring the outcomes of public education programs.

The influence of the personalisation and accountability movements combined with the impetus provided by the Comprehensive Elementary Teacher Education Models program of the USOE initiated the Performance-Based Teacher Education (PBTE) movement,

which brought together many of the new ideas about education and training that were circulating in the 1960s. The PBTE movement received substantial support from the Bureau of Educational Personnel Development within the USOE through the 1970s. During this period the movement sought to clarify its own problems and concepts. Important contributions to this effort were made by the Committee on Performance-Based Teacher Education established by the American Association of Colleges for Teacher Education (AACTE). This committee was given responsibility to 'study the many efforts currently taking place in the United States in the area of performance-based teacher education. Based on this study, the Committee is further charged to give direction to these developments…' (Elam 1971: iii). The first report issued by the Committee (funded by the Texas Education Agency under contract with the USOE) was the seminal *Performance-based teacher education. What is the state of the art?* prepared by Elam (1971). This paper surveyed the field of PBTE, and specified 'essential', 'implied' and 'desirable' characteristics of PBTE programs. Elam (1971: 7) stated that only those professional teacher training programs that included all of the essential elements would fall within the AACTE definition of PBTE. Elam's *essential* characteristics of a PBTE program were:

1. Competencies (knowledge, skills, behaviors) to be demonstrated by the student are
   - derived from explicit conceptions of teacher roles,
   - stated so as to make possible assessment of a student's behavior in relation to specific competencies, and
   - made public in advance;
2. Criteria to be employed in assessing competencies are
   - based upon, and in harmony with, specified competencies,
   - explicit in stating expected levels of mastery under specified conditions, and
   - made public in advance;

3. Assessment of the student's competency
   - uses performance as the primary source of evidence,
   - takes into account evidence of the student's knowledge relevant to planning for, analyzing, interpreting, or evaluating situations or behaviour, and
   - strives for objectivity;
4. The student's rate of progress through the program is determined by demonstrated competency rather than by time or course completion;
5. The instructional program is intended to facilitate the development and evaluation of the student's achievement of competencies specified (Elam 1971: 6–7).

Elam's (1971) list of essential criteria for PBTE programs is so significant in the development of CBT that they are regularly quoted in texts dealing with the origins of CBT (e.g. Houston 1974: 9, Tuxworth 1989: 15, Harris *et al.* 1995: 18–19). Throughout the 1970s attempts were made to build on and refine these criteria, for example Houston and Howsam (1972), Burke, Hansen, Houston and Conant (1975) and Norton *et al.* (1978), although none of Elam's (1971) original essential criteria were subsequently disavowed.

In parallel with the federal government's efforts to shape and operationalise the theory of PBTE was a push by state governments to introduce certification policies linked to PBTE. Tuxworth (1989: 12) explained that for many administrators, politicians and state certification agencies the PBTE movement carried a high level of 'face validity'. It seemed obvious that, with the development of agreed and public performance standards for teachers and objective assessment mechanisms, societal demands for accountability and quality improvement in education could potentially be satisfied. An over-supply of teaching college graduates facilitated the implementation of the certification policies (Tuxworth 1989: 13).

The USOE continued its support for PBTE in the 1970s despite criticisms ranging from complaints about the theoretical coherence of the movement to outcry over the lack of objective evidence for the success of the movement and a backlash against over-hasty introduction of competency-based programs (Tuxworth 1989: 12). By the end of the 1970s, the teacher education reform movement – at this stage also referred to as 'competency'-based rather than just 'performance'-based education – had matured into an orthodoxy entrenched in the majority of teacher training institutions in the United States. The theoretical underpinnings of the movement, meanwhile, had cohered into a consistent framework characterised by a level of sophistication that made it appeal to training and education reformers both outside the context of teacher preparation and outside of the United States. The next section focuses on these theoretical underpinnings.

Theoretical origins of competency-based training

An analysis of the theoretical underpinnings of CBT brings to light two kinds of bases: broad *influences* and specific *contributions*. The theoretical influences serve to contextualise and coordinate the theoretical contributions, while the contributions themselves are the actual techniques, principles and rules that govern the practice of the professionals who organise and implement CBT. The two key theoretical influences on the development of CBT are behavioural psychology and systems theory. In the case of the theoretical contributions, they have been categorised according to the aspects of CBT to which they contribute: the objectives, the learning process or the assessment.

Theoretical influences on CBT

The significance of both behavioural psychology and systems theory for the development of CBT is explicitly acknowledged by McDonald (1974: 17), but can also be traced in the specifications for the 1968

Comprehensive Elementary Teacher Education Models program that was so important for the evolution of CBT. However, the original conjunction of these two theoretical frameworks was brought about for the improvement of training by psychologists and other personnel development experts working for the United States armed forces in the 1940s and 1950s. During World War II and the Cold War, the United States military encountered a range of human resource development challenges, ranging from the problem of preparing large numbers of competent combatants to the training of personnel to operate rapidly evolving advanced weapons systems. During this period, the United States military employed large numbers of specialists to study and overcome these challenges. By the time the Sputnik crisis quickened the research efforts of civilian educational authorities, the United States military was already well advanced in its attempts to find scientifically-grounded solutions to the question of how to design and execute the most effective training. The importance of the military contribution to the development of CBT can be gauged by events such as the United States Office of Naval Research-sponsored conference at the University of Pittsburgh in 1960 which brought together specialists including Robert Glaser, Robert Gagné, Bob Miller, John Carroll and Meredith Crawford (Glaser 1962). The purpose of this conference was to investigate how advances in educational psychology arising from research into the needs of the United States military could be applied to general problems in education and training. Over the next few years, members of this group laid much of the theoretical groundwork of CBT through the development of the theory of 'educational technology'.

Most of the psychologists who lent their efforts to the problem of effective training in the United States military came from a behavioural background. Behavioural psychology or 'behaviourism' drew its inspiration from the tradition of 'British Empiricism'. This latter philosophy worked on the premise that our sensory experience is the ultimate foundation of our knowledge. While this may sound

obvious and common-sensical to our current way of thinking, it must be noted that there was a time when philosophers and even scientists believed that knowledge was in some way innate in us, or somehow transmitted directly to our minds through divine sources. It was therefore something of a revolutionary act when John Locke (1690: 89) argued that at birth the human mind is a clean slate or 'white paper devoid of characters' and that our sensory or 'empirical' experience furnishes us with knowledge over time. As Gagné (1965: 7–8) points out in his survey of the history of learning theory, this British approach to the philosophy of mind was given an American twist by thinkers such as William James and John Dewey who believed that the real question was not so much how our *knowledge* is derived from experience, but how our *action* is shaped by experience. Gagné emphasises the American tendency to favour questions about action rather than ideas in his account.

Empiricism – also called 'associationism' due to the stress placed on the problem of the association between sensation and our thoughts or actions – influenced the early development of scientific enquiry into the mind or 'psychology'. However, at first the discipline of psychology got caught up in a complex and apparently interminable argument concerning the precise nature of mental entities and exactly how scientific experiments could be conducted to generate objective knowledge of psychological phenomena. Controversy raged between so-called 'functionalists' and 'structuralists', although both sides accepted the methodology of 'introspection' as the way to gain access to mental phenomena (e.g. Titchener 1898). This 'experimental' method involved concentrating on subjective experience and reporting it in a systematic way. Problems arose in regard to the consistency and replicability of findings produced using introspection, but it was not the method but rather the adequacy of the researcher's ability to employ introspection that was called into question (Titchener, 1912).

In 1913 the American scientist John B. Watson published a strong critique of associationist psychology, arguing that the method of introspection was the real source of the controversies within psychology. Watson's early work was on learning in rats, during which time he found that he was able to frame and test hypotheses regarding this learning that were expressed purely in terms of the externally observable behaviour of the animals. In his 'Psychology as the behaviorist views it' (1913), he suggested on the basis of Darwin's new theory that animal and human life actually formed a continuum, and it was legitimate to transfer the method he used in his experiments on rats to the study of learning in humans. In other words, he proposed to study human psychology solely in terms of observable behaviour. The corollary of this approach was, just as the experiments on learning in animals did not appeal to mental states in the subjects, it would not be necessary to deal directly with mental states in human subjects. Watson (1913: 3) concluded that '[t]he time seems to have come when psychology must discard all reference to consciousness…'. In Watson's view, by focusing exclusively on describing and understanding objectively observable behaviour, psychology could be regarded as a true science for the first time.

The new American School of behaviourist psychology was fundamentally concerned with animal and human learning, since it is only by manipulating behaviour and observing resulting changes that causal relationships can be identified and described. The concepts of reflex, stimulus and response which became central to behavioural learning theory were drawn from the work of Pavlov, a Russian physiologist interested in animal behaviour. He explained that the notion of 'reflex' was pioneered by the sixteenth century philosopher Descartes who believed that the physical body could be regarded as a machine (Pavlov 1927: 4). In Descartes' theory, a necessary connection ('reflex') existed between a given external influence on the organism ('stimulus') and the resulting reaction by the organism ('response'). Pavlov found Descartes' schema, with its

strict determinism, useful in describing his work on manipulating the behaviour of dogs. Pavlov made a significant contribution to learning theory by conceptualising the difference between unconditioned and conditioned reflexes (Pavlov 1927: 25). According to Pavlov, innate reflexes (responses to stimuli with which we are supposedly born) can become modified or conditioned through external events, for example when a dog salivates because it has detected the preparation of food. In this case a conditioned stimulus (the activity of food being prepared) has become substituted for an unconditioned stimulus (the taste of the food). In Pavlov's language, the new stimulus is said to be 'reinforced' by the unconditioned stimulus, and can become established so that the conditioned stimulus alone initiates the reflex (Pavlov 1927: 25). Pavlov famously submitted the process of the formation of conditioned reflexes to experimental study and was able to describe relationships between conditioned and unconditioned stimuli in quantitative terms.

Also working in the early part of the twentieth century, Thorndike advocated the study of the externally observable behaviour of organisms (including humans) as a way to supplement explanations that depended on the postulation of states of consciousness (Thorndike 1911: 2). Thorndike and Pavlov did their early work in ignorance of each other, although they shared a vision of a science of behaviour derived from the study of animals and humans alike under experimental conditions. One of Thorndike's key experiments involved placing cats in an environment that included levers which, when pressed, would lead to the appearance of food. Thorndike measured the time taken for the animals to accidentally activate the lever and then repeated the conditions until the subject would use the lever without delay when exposed to the same conditions (Skinner 1953: 60). Charting these measurements, Thorndike demonstrated that his subjects followed 'learning curves' on the way to proficiency with their environments, and accounted for the 'stamping in' of the

efficacious behaviour with the concept of the 'Law of Effect' (Skinner 1953: 60).

Skinner accepted the strict doctrine of behaviourism espoused by Watson and at the same time built on the work of Pavlov and Thorndike in the area of learning theory. His major contribution to behaviourism was the theory of 'operant conditioning'. While he admired the work of Pavlov, he believed that the concept of the reflex as conceived by Pavlov failed to explain the full range of learning phenomena (Skinner 1953: 56). In particular, he thought that Pavlov's conditioned reflexes could only account for very basic behaviour, especially in humans, since the modification of behaviour was only effective when the stimulus was systematically manipulated. Skinner saw Thorndike's work as suggesting the more fruitful direction for research because Thorndike's subjects elicited the reinforcement by their own behaviour, not through the decision of the experimenter (Skinner 1953: 62). Skinner experimented on pigeons, determining in advance that a certain kind of behaviour – 'operant behaviour' – would serve to trigger reinforcement. The experimenter would simply wait until the operant behaviour manifested and then apply the reinforcement, which was generally food given to hungry birds. Skinner created the idea of 'shaping' behaviour towards very specific forms by gradually narrowing the effective range of operant behaviour. For example, if the desired behaviour of the pigeon was pecking at a spot on the wall, the operant behaviour might initially be any movement by the bird in the direction of the target wall, and then any movement towards the spot on the wall and then finally only pecking at the spot. By shaping behaviour through gradually focussing operant behaviour, Skinner (1953: 63–66) was able to rapidly teach his subjects a wide repertoire of specified behaviours.

The theory of behaviourism with its emphasis on learning theory has strongly influenced the development and general approach of CBT. The emphasis in CBT on the expression of competencies

in 'behavioural' terms and the focus in CBT assessment on the observable behaviours of the learner are the more obvious legacies of behavioural psychology. When we deal shortly with specific contributions to CBT, it will become clear that there are many more elements of CBT that bear the behavioural imprint.

The second major theoretical influence on CBT is 'systems theory'. This inter-disciplinary philosophy was first treated explicitly in the work of Ludwig von Bertalanffy in the 1930s. Bertalanffy, a biologist and polymath, observed that where sciences deal with collections of interacting individual elements, for example economics or biology, theoretical descriptions of the phenomena display significant similarities, to the extent that a general theory of these 'systems' becomes possible (Bertalanffy 1955: 30). He wrote that 'there exist models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations or 'forces' between them' (Bertalanffy 1955: 31). Although Bertalanffy saw systems theory as an alternative to the reductionism of science that sought to explain through reducing phenomena to their most basic units, he believed that strict mathematical description of system constants was possible. Bertalanffy defined a 'system' broadly as 'complexes of elements standing in interaction' (1955: 32). General aspects of systems include whether the system is open or closed (1955: 38–40), the purpose of the system (1955: 44–46) and entropy (1955: 40–44).

The application of systems theory to training was an upshot of the problems encountered by the United States military during World War II in preparing large numbers of people to take various roles. In her treatment of the relations between systems theory and training, Crawford (1962: 303–309) described large organisations as 'parent systems', the specific parts of the system that produce or directly contribute to the output of the parent system the 'operating subsystems', and the subsystems that support operations the

'personnel subsystem' and the 'training subsystem' (although these latter two may form a single subsystem). According to Crawford (1962: 305), one of the largest training subsystems ever invented was that of the United States Army during World War II. As Cold War tensions built during the 1950s and 60s, the refinement of systems theory as it applied to military training continued with important consequences for CBT. The focus was on the creation of 'man-machine systems' such as missile launch systems or fighter aircraft. The prevailing political climate demanded rapid development and deployment of such systems. Military systems theorists such as Gagné distinguished between machine system development and human 'component' development (1962: 4), and identified on the human development side phases that included task description, task analysis, job design, training, and performance measures. Kennedy (1962: 20) differentiated the issue of training for system operations into the specific problems of individual training, environmental supports, team training and system training.

Systems theory has had two enduring influences on CBT. On the one hand, there follows from the view of training as a personnel subsystem an emphasis on the orientation of training design to the systemic needs of the 'parent system' in which the training subsystem is embedded. The contemporary emphasis in CBT on relevance for industry has its theoretical roots in the conception of training as a subsystem. On the other hand, systems theory condoned the conceptual isolation of subsystems and the treatment of them as systems in their own right. As a consequence, training activities could be approached as an individual system, and a specific type of system came to be adopted as the ideal model of training. This kind of system – called 'cybernetics' – is a subclass of general systems theory (Bertalanffy 1955: 43) that was characterised by 'feedback loops'. The cybernetic model of the training system remains a powerful influence on CBT (e.g. McDonald 1974: 27).

The understanding of CBT as a system also helps to explain one of the difficulties in classifying CBT in relation to other theories of adult learning. The difficulty lies in the fact that CBT cannot be seen as a single theory of learning, but must be understood as an amalgam of theories in a dynamic relationship to its social context. In the language of systems theory, CBT is an 'open system', constitutionally responsive to a wide range of 'inputs'. The appropriateness and 'fit' of the theoretical components is determined primarily by the function they serve in the system rather than their inherent compatibility with each other. This principle of theoretical contiguity accounts for the fact that elements which are at odds with behaviourism on a strictly philosophical level can coexist in CBT. It is, then, the system aspect of CBT that holds the amalgam of heterogeneous theoretical components together and underlies the endurance of CBT as a collectivity.

Theoretical contributions to CBT

One of the most distinctive characteristics of CBT is the emphasis placed on the identification and expression of learning objectives, an emphasis reflected in the 'competency' within the title of the movement. The basic idea of emphasising educational objectives was given its definitive form in the work of educational theorist Ralph Tyler (1949). He believed that the weakness in the curriculum theory of his time was the failure to be clear about the purposes of curriculum. Tyler portrayed the prevailing approach to curriculum design as focused on the content of areas of knowledge. He rejected the notion that the content of the traditional academic disciplines was a sufficient basis for structuring curriculum. He criticised contemporary attempts to formulate goals of education because they expressed what the instructor would do rather than what the students were supposed to be able to do (1949: 44). Tyler argued that curriculum design should be determined by explicit curriculum

objectives expressed purely in terms of the changes the learning was supposed to produce in the *behaviour* of students.

Tyler's understanding of the importance of educational objectives and their role in the design of learning was elaborated in the work of Bloom (1956). Along with a 'committee of college and university examiners', Bloom set out to codify the field of educational goals. The group believed that the language and structuring principles – the 'taxonomy' – of objectives needed to be rendered consistent so that comparison and collaboration on the formation of objectives by educational professionals would be possible (1956: 20). Bloom's taxonomy is an important step on the way to CBT since it stresses the importance of the communicability of educational purposes. The taxonomy was also important because it structured the entire field of educational goals into the 'cognitive', 'affective' and 'psychomotor' domains (1956: 7), a structure which is closely related to the contemporary concept of competency as made up of knowledge, attitude and skill components.

However, the work of Tyler (1949) and Bloom (1956) is of limited relevance to training since they were chiefly concerned with objectives in the realm of *education*. In the early phase of the development of CBT, a distinction was made between education and training as such. According to Glaser (1962: 3–5), the distinction could be made in two ways. He says that training involves specificity of behavioural 'end-products', while these end-products cannot be known with any precision for education. The second way of distinguishing education and training focuses on whether learning experiences amplify individual differences or tend to produce uniformity of behaviour. In other words, training aims to teach individuals to perform similar behaviours, whilst education seeks to develop behaviours in the individual that are singular. Crawford's (1962: 302) treatment of the distinction follows Glaser's second account, and adds that training is something arranged and funded by 'parent systems' to develop

human components in operating systems, while education is generally funded by the individual. In the light of Glaser's and Crawford's conceptions of training, it is clear that learning objectives could not be borrowed from Bloom's taxonomy, but needed to be derived from the operational requirements of man-machine systems in the form of task analyses.

Early work on vocationally-oriented objectives was done by McGehee and Thayer (1961, in Miller 1962), Mager (1962) and Gagné (1962), although it was Miller (1962, 1963) who comprehensively articulated the methods necessary to determine training objectives. Miller's approach was influenced by the analyses of Taylor (1906) who studied the industrial workplace and articulated 'principles of scientific management'. Taylor (1906: 31) explained that one of the obstacles to the design and management of an efficient and productive workplace was the inconsistency of skills displayed by different qualified tradesmen. In Taylor's view, it was the traditional apprenticeship system with its 'rule-of-thumb' principles that produced this wide variation of proficiency in workers. But this situation created a problem for management that needed to be able to assume consistent skill levels for the design of efficient workflows. Taylor's (1906: 36–7) theory called for the break-down of jobs into definable tasks which would then form the basis of a scientific approach to increasing industrial productivity. Miller (1962: 33) also cites the influence of Gilbreth, who refined Taylor's ideas by working out how to quantify task design through 'time and motion studies' that could specify the component 'micromotions' of tasks. According to Miller (1962: 33–4), the theory of task analysis became critical during the 1950s when the United States Air Force was developing weapons systems at such a pace that personnel training needed to be undertaken before the production of equipment was complete. Close cooperation between engineers and training designers was necessary to identify the tasks that military personnel would be called upon to perform once the machinery was ready.

Miller (1962: 48–9) identified three kinds of information that could be used for task design: performance requirements for the system in which the task is embedded, ideally expressed in terms of context and time limits; the direct observation of tasks being performed; and interviews with operators and supervisors who could help determine both outstanding and ineffective behaviours. The functional requirements of tasks called for the specification of kinds and amounts of output required, and the identification of tolerance limits; input variables and conditions also needed specification, along with the equipment the operator was expected to use to transform inputs into outputs. The statement of these functional requirements lead to the task description. According to Miller (1962: 32), a 'good' task description will identify what criterion responses should be made to what task stimuli under what range of conditions. Miller (1962: 52) also advised that task descriptions should indicate what the machine operator was expected to do under unusual conditions, such as input overload or equipment failure, and that training needed to address such irregularities. Miller's analysis of task description requirements has been a pivotal influence on the way competency standards are structured and expressed within contemporary CBT.

The main contributions to the learning process in CBT come from behaviourism and 'mastery learning' theory. It is in the area of the learning process in CBT that behaviourism's influence is least certain. Perhaps this is due to the fact that, unlike the formulation of learning objectives and the assessment of learning in CBT, which as inherently public processes are amenable to behavioural analysis and description, the analysis of the process of learning with its private dimension readily resorts to the concept of the subjectivity of the learner, and subjectivity is a notion eschewed by behaviourism. However, behavioural learning theory has its own account of learning based on descriptions of the external aspects of the process.

Skinner's theory of operant conditioning, mentioned above, has influenced the development of CBT by contributing the conception of the learner as an active agent in the process of learning. It will be recalled that the difference between Pavlov's 'classical' conditioning and operant conditioning is that, in the former, reinforcement is applied in learning according to an externally applied schedule, whereas in operant conditioning the activity of the learner alone triggers reinforcement. The effectiveness of operant conditioning to shape behaviour depends in part on the speed with which reinforcement is delivered to the individual, while this reinforcement can take the relatively subtle form of the learner simply discovering that they have made the correct response. For Skinner (1954: 15–19), these facts recommended the application of operant conditioning principles to school learning, although traditional learning methods were ill-suited to implement his model. As a result, Skinner (1958: 39) advocated the use of 'teaching machines' and 'programmed learning' manuals that allowed the individual learner to receive timely reinforcement for displaying the desired behaviour. As a corollary, the role of the teacher would need to change from being the source of the content to be learned to a facilitator and trouble-shooter supporting the learning process (1954: 26–27). Other important implications were that learning content would need to be structured in such a way as to allow for learning in discrete chunks so that the shaping influence of reinforcement could be brought to bear at regular intervals, and that learners would progress at their own pace within certain limits (1965: 65).

Apart from the contributions of behaviourism to learning process concepts in CBT are those of mastery learning. This theory had an early precursor in the work of Kornhauser (1927) who made a number of recommendations for the reform of apprentice training. He criticised existing training methods on several grounds, including the allocation of fixed periods of time to the development of skills in apprentices. Kornhauser complained that this system failed to

recognise that 'one boy may be able to learn as much in a year as another learns in three or four years' (p. 217). He also blamed a lack of incentives for high apprentice drop-out rates, and believed that poor methods of instruction were common. Kornhauser's proposed reform of training was guided by two principles: that provision be made for wide differences of ability between individual apprentices, and that '[t]he immediate aims of the apprentice course and the ground to be covered are made quite definite and specific in the minds of those concerned – apprentice, apprentice supervisor, and management' (p.217). In addition, Kornhauser proposed that the progress of an individual apprentice be determined by level of ability, and that as a result, no set period of time was to be allocated for any part of the training, that 'proficiency' was to be measured by job tests and oral examinations as a basis for advancement, and that these tests were not only a measuring technique, but the 'goal, stimulus, and means of instruction' (p.217). Kornhauser's recommendations were influential in the early development of CBT, and share some features with the theory of learning advocated by Skinner.

The educational theorist Carroll (1963) provided the first complete model of mastery learning. He was concerned with the problem of improving the effectiveness of school instruction which at that time nurtured the achievement of only a minority of students. Carroll challenged this educational mindset with his 'model of school learning'. The fundamental assumption of his model was that 'the learner will succeed in learning a given task to the extent that he spends the time that he *needs* to learn the task' (p. 725). Carroll distinguished in his model between factors that stemmed from the individual learner (aptitude, or time needed to learn the task under ideal instruction, ability to understand instruction, and perseverance) and external conditions (the time allowed for learning, and the quality of instruction). He speculated that under- and over-achievement in learning could be traced back to specific combinations of these variables, and that systematically maximising time allowed for

learning and improving the quality of instruction would cater for individual needs, resulting in the success of the majority of learners (p. 730).

Bloom (1968) realised the potential of mastery learning by building on Carroll's model. His assessment of the reality of educational effectiveness in the United States indicated that only about one third of students could be said to 'succeed' in their years of schooling, while a third could be said to 'fail'. The remainder attained a barely adequate level of education. However, Bloom (1968: 3) suggested that by adopting mastery learning strategies, up to 95% of learners would succeed in their schooling. Bloom explained that '[t]here are many alternative strategies for mastery learning. Each strategy must find some way of dealing with individual differences in learners through some means of relating the instruction to the needs and characteristics of the learners' (p. 7). He argued that each strategy had to deal with the five factors identified by Carroll – aptitude, quality of instruction, ability to understand instruction, perseverance and time allowed for learning (1968: 2–3). One strategy proposed by Bloom (1968: 7) was to provide each student with individual tuition, but he conceded that this proposal would be too costly in practice. More realistic strategies he proposed were to allow students to learn at their own pace, guiding students in which courses they should or should not take and providing different streams for different groups of learners (p. 7). Another strategy Bloom (1968: 7) researched involved combining traditional group instruction with a regime of 'diagnostic procedures and alternative instructional methods' whereby students falling short of mastery were identified and provided with customised instruction that addressed individual needs. Bloom reported that this method succeeded in bringing a large proportion of students up to the desired standard of achievement. As a result of this research, Bloom (1968: 8–11) argued that preconditions of mastery learning were the specification of learning objectives and content for both students and teachers and the use of assessment procedures that allowed students

and teachers to recognise when instruction has been effective. In addition, Bloom recommended that courses or subjects be broken down into smaller learning units, and that student progress in these units be monitored through the application of 'formative' assessment. Through the use of this diagnostic technique – pioneered by Scriven (1967) – Bloom believed that mastery of each learning task could be ensured, and that timely feedback could be supplied to teachers and students for possible remedial action.

Bloom's notion of mastery learning represents a humanistic contribution to CBT. The emphasis on subjective and cognitive factors such as aptitude, ability to understand instruction and perseverance moves mastery learning beyond the ken of behaviourism. On the other hand, Bloom's (1968: 2) advocacy of mastery learning sprang from a humanist concern for the social and emotional consequences of the failure of the majority of learners to succeed in the traditional approach to education. Bloom (1968: 11) argued that the self-concept of students would be improved through mastery learning and the neuroses that he believed followed from painful and frustrating experiences at school could be avoided. He also suggested that mastery learning would contribute to a positive regard for learning in the majority of people that would lead to a broad enthusiasm for learning beyond the level of compulsory schooling (p. 11).

The final group of contributions to be considered here relate to the assessment of student performance. Glaser (1962) made a significant contribution to this area by distinguishing between 'norm-referenced' and 'content-referenced' measures of performance, and championing the use of the latter in training systems. He uses the term 'norm-referenced' to refer to the assessment of proficiency that measures a student's performance relative to that of other students. Results of this kind of assessment will disclose the standing of the student against a norm. However, as Glaser (1962: 20) points out, norm-referenced measures tell us little about how the student (and indeed

the group as a whole) performs in relation to the content of learning. In another treatment of assessment measures, Glaser (1963: 49) cited Thorndike as criticising norm-referenced testing for its 'relativity and indefiniteness'. Based on indications in earlier work by Flanagan (1951, in Glaser 1963) and Ebel (1960, in Glaser 1963), Glaser proposed that testing should refer rather to the subject matter or content of the program of learning and indicate whether the student has developed the 'terminal behaviours' intended in the design of the course. A further advantage of criterion-referenced assessment was that it would supply information for training designers on the effectiveness of their program.

Glaser's proposal for content-referenced performance measurement was refined during the 1960s and 70s by a number of theorists such as Popham and Husek (1972). During this period, it was assumed that criterion-referenced measures aimed to yield information regarding how near or far a testee's actual performance was from the criterion performance, although Popham and Husek (1972: 32) acknowledged the possibility of producing scores that are 'essentially "on-off" in nature', that is, the testee either did or did not achieve the criterion. They suggested that usually the measure will refer to a range of acceptable performance (pp. 32–33). Passing this kind of test might involve scoring 90% or higher on the criterion-referenced assessment. Towards the end of the 1970s, however, a movement with political and social roots advocated the use of 'Minimum Competency Testing'. It was believed that reporting whether a student had mastered course material or not was a sufficient educational measure, and that this approach would remove the stigmatising effect produced by reporting the ranking of students. Hambleton and Eignor (1980: 369) stated that a minimum competency test 'is designed to determine whether an examinee has reached a prespecified level of performance relative to each competency being measured'. They proposed that such testing would separate students into two categories: either 'master'/'competent' or 'nonmaster'/'incompetent', and would

produce as many competency decisions as there are competencies to be measured (p. 369). Hambleton and Eignor (1980: 370) noted that minimum competency tests were a form of criterion-referenced test, and needed to address the same issues in assessment design. With the advent of minimum competency testing theory, the transformation of criterion-referenced performance measurement into a procedure for determining whether a learner was 'competent' or 'not-yet-competent' (the terminology now used in CBT systems) was complete.

By the end of the 1970s, the PBTE movement had brought most of these theoretical contributions together into a comprehensive 'system'. The objectives of the new teacher education programs were to be expressed in behavioural terms, and be based on the analysis of actual work roles. Whether these analyses construed work roles in terms of performances or competencies, the emphasis remained on observable behaviours that could be made publicly available and would serve to guide the design of instruction and assessment. Instruction within the PBTE system itself focused on the student who was expected to be an active and responsible participant in educational programs that were designed to promote mastery of content defined by the program objectives. The assessment of student achievement in PBTE programs explicitly referred to the performance criteria specified in the program objectives, and aspired to indicate the extent to which the student could demonstrate mastery of the program content rather than their standing in relation to the achievement of other students.

Conclusion

This discussion has attempted to trace both the societal and theoretical origins of CBT. On the societal side, a number of political events and public debates in the United States in the 1950s, 60s and 70s have been identified as producing an environment that favoured the development of a certain kind of educational philosophy,

culminating in the PBTE movement of the 1970s. This movement drew upon theoretical resources grounded in behaviourism and systems theory that had been fruitfully combined by specialists concerned with the training of personnel in the United States armed forces. Humanist contributions to the development of CBT were also made in the form of mastery learning.

While the preceding discussion has outlined the *origins* of CBT, a range of other explorations would be necessary to produce a complete picture of the *evolution* of this movement that continues to have significant social implications in a number of countries (e.g. Argüelles & Gonczi 2000). For example, a treatment of the concept of competency would be necessary to exhibit the vicissitudes of the notion and the nuances in thinking regarding its ultimate components. Although competency is understood to be comprised of knowledge, skills and attitudes today, there have been other conceptions of the nature of competency as well as a struggle (alluded to in the introduction) over the appropriateness of the use of the concept to encapsulate the essence of the movement. A fuller understanding of the phenomenon of CBT would also be facilitated by an account of the international dimension of the movement. For example, developments in the UK beginning in the 1980s are of great significance to the movement. Finally, the Australian student of CBT would benefit from a detailed examination of the introduction and rise of the movement in this country where, after a period of uncertainty and controversy through the 1990s, it has now assumed such a strong position in VET policy and practice that it is almost difficult to imagine a different state of things.

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