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## **A preliminary exploration of the knowledge/skills of third year metal trades apprentices after the introduction of CBT**

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### **Abstract**

*Competency-based training remains a major plank in government policy for VET reform. This is despite mounting evidence that competency-based training may not be leading to the desired increase in knowledge and performance. This paper reports findings from a preliminary investigation into the knowledge/skill levels of third (final) year Metal Trades apprentices after the introduction of competency-based training. In the part of the ongoing research reported, the students were tested using some items from a pre-competency-based training test in order to ascertain whether still occupationally relevant knowledge was in fact known by this CBT trained group of students.*

### **Background**

The impact of the technological, economic and social revolutions of the late eighties led the Australian federal Labor government to embrace competency-based training (CBT) as a foundation for reform and the solution to problems centred on international competitiveness, productivity and national prosperity (Cornford 2000). Consequently, from the early nineties, there have been sustained efforts to implement CBT widely throughout Australia through the policy directives and financial power of the Australian federal government (eg see Smith & Keating 1997).

Metal Trades was one of the areas in which CBT was originally trialed as early as 1990 and it was implemented soon after without any extensive evaluation of these less than adequate trials (Lidbury 1995). Subsequent research by Lidbury (1995) in the Hunter region of NSW revealed that there was a poor lack of understanding among employers of what CBT actually involved and their roles in the learning of their own apprentices under a CBT system.

More recent research evaluating CBT identified failure of the approach to increase levels of productivity and international competitiveness with several studies indicating teachers did not consider that it had actually increased skill levels as was intended with adoption of it (Cornford 1996, 1997, 2000). There is much anecdotal evidence of the apparent failures of CBT. One only has to enter into just about any TAFE staffroom and listen to the conversations to be apprised of this. Previous research in the Metal Trades area (Mills 1994) found 93% of teachers surveyed expressing concern over aspects of the implementation of CBT.

Litigation in the courts may provide some further evidence of decline in standards of learning and skill achieved under CBT. Currently there are two cases before NSW courts involving construction companies claiming damages from subcontractors. The

bases of their claims are alleged lack of cognitive and practical skills within the subcontracting labour force with this resulting in substandard work. This has brought further scrutiny to the influence of CBT within the industry. In addition a number of employment vacancies advertised in the Hunter region have specifically indicated 'Pre-CBT trained persons preferred' (eg Employment vacancies, *Newcastle Herald*, 14 September, 1995). All of these factors indicate a need to evaluate the quality of learning within the metal trades and other areas after the implementation of CBT.

Even those apparently previously enthusiastic supporters of CBT now acknowledge that there are problems with the approach in achieving superior learning and performance outcomes with students. Erica Smith, who has researched the implementation of CBT very thoroughly (eg see Smith & Keating 1997), in her submission to the Senate Inquiry into the Quality of Vocational Education and Training in Australia stated: 'While CBT has been much researched there is as yet no research which shows that CBT has improved student outcomes. Such anecdotal evidence that has been gathered indicates that outcomes are lower, ie students of the VET system are less skilled than they were ten years ago, as a result of CBT.' (Smith 1999, p.178). In this Smith is echoing the findings of earlier studies conducted by Cornford (1996, 1997), and summarised and reported in his evaluation of the implementation of CBT (Cornford 2000). This study reported here was undertaken in an attempt to provide empirical evidence to support the contention that the quality and effectiveness of student learning has declined since the introduction of CBT contention. Hitherto the evidence available has not been empirical, but largely anecdotal, as Smith's (1999) submission to the Senate Inquiry indicated.

### **Research Strategy**

Most of the previous attempts at evaluating the impact of CBT upon student learning outcomes to date have been based on qualitative data and approaches (Cornford 2000; Smith et al 1999; also see Mulcahy & James 1999, Billett et al 1999). This research sought to compare the learning outcomes of third year Fitting and Machining apprentices in the metal trades area in 1999 with the results achieved on a test last used prior to the introduction of CBT into the metal trades area in 1989. The last time that metal trades apprentices were subjected to an 'end of course' written assessment was in fact 1989. The paper selected was 5210H Mechanical Fitting Technology, which assessed basic fitting and machining knowledge and skills via a written paper with various problems often requiring mathematic calculations. This type of assessment was Class A, a test that was externally prepared by the relevant faculty, distributed state-wide and marked externally. The strategy adopted in the research reported here was to take the test that was used in 1989, to administer this to two classes of these final year apprentices whose teachers volunteered to participate in 1999, and to compare the outcomes with the 1989 state-wide results.

To ensure current validity of content it was necessary to ensure that the material taught in 1989 was still relevant and current in the 1999 Fitting and Machining Syllabus. To ensure that this was achieved, two teachers from the relevant faculty subjected the paper to independent scrutiny for current content compliance. Both teachers who performed this scrutiny of the test had at least 15 years teaching and relevant industrial experience. As a result of this process, seven questions were excluded from the earlier test that was administered to third year apprentices in 1999: three on advanced maths; and two each from advanced trigonometry and costing and

estimating. This amounted to the removal of 8 marks from a paper of 170 marks, slightly less than 5% of the test paper in terms of total marks.

### **Limitations of this Research**

What is reported on here is a preliminary study into the relative levels of knowledge/skills of third year metal trades apprentices after the introduction of CBT. This is only part of wider research being undertaken for a doctoral degree in the Faculty of Education at UTS by the first author. The total research project involves both quantitative and qualitative approaches and seeks to explore the wider issue of the impact of CBT in a specialist, important trade area with the views of employers, teachers and students being sought. What is being undertaken is essentially an evaluation of the effects of CBT in the metal trades area. Evaluation is widely recognised as involving complex decision making using a wide variety of evidence obtained from multiple sources (Owen & Rogers 1998). As an evaluation, the following, acknowledged problems with this research will be taken into account in arriving at an overall set of judgments.

Any testing across time will encounter problems occasioned by changes in the intervening period (Campbell & Stanley 1966). However, there is a long tradition in some areas of testing-retesting to establish reliability that, because of separation in time, from the original testing will encounter some of the problems identified by Campbell and Stanley (1966). For example in intelligence testing there is for example a well-known phenomenon established through testing where succeeding generations score more highly than those originally tested earlier with the same form of the test (eg see Herrnstein & Murray, 1994; Jacoby & Glauberman 1995). The increased levels of intelligence scores are often attributed to the effectiveness of schooling and a more knowledgeable population on account of the access to media reporting, ie other intervening variables.

The relatively small number of students involved in retesting in this study (29) is less than optimal, but by comparison with some qualitative studies the sample size is really quite large. Many qualitative doctoral research projects have only one or a handful of subjects. The relatively small number of students involved in this research was fewer than originally planned, but resulted because of external factors such as industrial disputes within NSW TAFE at the time when the exam was to be administered. On account of the dispute and the redundancies that were a clear threat to the tenure of teachers, some teachers declined to take part in the examining process since they felt it might reflect on their teaching and make them targets for redundancy or non-renewal of contract. It is hoped that administration of the same exam in a more stable industrial environment will provide additional results for comparison in the future.

It is also hoped to locate additional, detailed information concerning past results to remove from these results the same questions that were removed from the presently used form of the test. While only a small percentage of the test (5%) has been altered (that is removed, see above), and consequently should not have influenced the outcomes of the comparison unduly, removal of these items would make the tests identical in terms of comparison of results.

### Classes and Students Administered Test

Two intact classes of Fitting and Machining students whose teachers volunteered to partake in the administering of the modified 1989 exam were administered the test towards the end of the last term in 1999. This is essentially a sample of convenience. The classes were located on two Hunter Region of TAFE campuses. There were 14 students in one class and 15 in the other, giving a total of 29 in all. All students were in the final year of their apprenticeship. Participating teachers were asked to advise students to one to two weeks in advance of the test in order to enable revision of module notes as would have been the case with pre-CBT students. For ethical reasons on the cover of the test paper students were advised that their results on this test would not affect their final results for the year.

### Results

The results from the test for the 29 third year Fitting and Machining apprentices are presented in Table 1 below.

Table 1: 1999 Test Results for Third Year Fitting and Machining Apprentices

Student Number	Result as %	Student Number	Result as %
1	13	16	29
2	13	17	31
3	16	18	31
4	17	19	31
5	18	20	33
6	19	21	33
7	22	22	34
8	22	23	34
9	23	24	35
10	24	25	36
11	26	26	38
12	27	27	38
13	27	28	83
14	27	29	84
15	29		M = 30.8 SD = 15.6

The mean test mark for the group was 30.8 and the standard deviation 15.6. Information supplied by the NSW TAFE Head of Division responsible for Fitting and Machining has indicated that, in pre-CBT papers where normative assessment was used, the state-wide results were adjusted so that approximately 85% of students passed. This necessitated the adjustment of final grades and, over a considerable period depending on the difficulty of the centrally set test, the pass mark varied between 40% and 60%, but never was dropped below 40%. For convenience, until more specific information comes to light, the pass grade here for the 1999 group will be regarded as a conventional 50%. However, inspection of the results in Table 1 indicates that only two of the 29 students achieved a mark greater than 50%. In effect only two students achieved a mark greater than 38%. This indicates that all but two of the 29 students would have failed even if the pass mark had been lowered to 40%, the lowest set pass rate ever in this subject. In effect, only 7% of the students re-tested with the modified 1989 paper passed, even at this (historically) lowest set pass mark.

It was subsequently discovered that the two students who had passed were also concurrently enrolled in a higher diploma. These students are thus somewhat atypical of the general run of third year Fitting and Machining apprentices and, if their scores of 83 and 84 were to be removed, the mean for the group would be somewhat lower.

### **Discussion**

The findings of such low average percentage scores and a low pass rate a decade after the introduction of CBT on a test consisting of currently relevant knowledge administered to final year apprentices in Fitting and Machining raise a number of questions. In effect providing an explanation of these findings raises complex issues. On face value the findings indicate that the same levels of achievement evident prior to the introduction of CBT have not been maintained. There are a number of possible reasons for this including: the quality of curriculum has changed and resulted in inferior learning, the quality of teaching has declined, the ability levels of students are now lower than a decade ago and that student motivation to perform on the test is lacking.

The curriculum approach has changed dramatically with the introduction of CBT. The emphasis with CBT is upon performance and, while there are some approaches to CBT which emphasise the importance of underpinning theory (eg see Hager & Gonczi 1993), it is by no means certain that these are the approaches that are predominating (Cornford 2000). However, it is relatively easy to argue that without any understanding of relevant theory, as through the cognitive phase in Fitts' skill learning theory, effective, skilled performance will not result (Fitts 1964, 1968). This is very much the case in the Fitting and Machining where satisfactory occupational performance requires understanding of considerable bodies of mathematical knowledge and associated skills in order to make appropriate calculations.

Two earlier surveys of NSW TAFE teachers, involving both more and less experienced teachers, by Cornford (1996, 1997) revealed major concerns by the teachers regarding sufficient attention to the teaching of theory and the levels of skills actually attained under CBT curriculum approaches. In both studies a very high proportion of teachers indicated that CBT had hindered or severely hindered students' attainment of skilled performance, with 63.9% of experienced teachers and 61.7% of less experienced teachers indicating this. While it is not possible to determine whether teaching quality per se has declined, these results indicated that the teachers who responded to the questionnaire surveys clearly considered that the introduction of the CBT curriculum had had a deleterious impact upon the effectiveness of their teaching as reflected in student learning. Administrators' and policy makers' maintenance of CBT in the face of such earlier published findings appears to indicate a belief that teachers did not have serious concerns, or that they did not particularly care about the impact upon general skill levels in the trades and professions in the longer term.

It is difficult to be certain whether ability levels of students at entry into the metal trades area are the same as they were a decade ago. The number of students has certainly decreased and there is quite reasonable evidence that TAFE enrolment is seen as less desirable than enrolment at a university. However, with the fall in numbers of available apprenticeship places, it is probable that employers would have

had a wider range of ability to choose from on account of the high levels of teenage unemployment over the past decade.

There is also the issue of whether the students who sat for this exam were highly motivated to achieve on it, given that it was not included in final assessment results, and, in fact on the cover of the test paper it was clearly indicated, for ethical reasons, that the results of the test would not affect their final results for the year. Yet it should be of concern if in fact these students did lack the motivation to demonstrate their knowledge and skills on important current, professional knowledge fundamental to Fitting and Machining. Generally, motivation of students under a CBT system has been perceived as a problem by teachers in specialty areas for some time (see Roux-Salembien, McDowell & Cornford 1996). This has led to the recent re-introduction of graded assessments, replacing the pass-fail criterion based assessment originally introduced with CBT, in NSW TAFE and some other state systems. This particular change to graded criterion assessment by administrators appears to have been driven by concerns of teachers and employers.

The success of the two students who scored in the low eighties runs against the general trend in results and also in terms of possible lack of motivation by students attempting the exam as a general explanation of results. The results obtained by these two students are explicable in terms of their enrolment in a higher diploma course. The observed general pattern in the scored results of students' inability to distinguish between close answers tends to indicate a general problem with levels of underpinning theory and thus understanding. Certainly the earlier studies by Cornford (1996, 1997) indicated that teachers were concerned about inadequate coverage of the theoretical underpinning with the CBT approach. Furthermore, if what is involved here were simply a motivation issue, it is doubtful whether the two highest scorers would have bothered to perform as they did.

### **Conclusion and Recommendations**

The results obtained paint an apparently disturbing picture of a decline in knowledge and skills of final year apprentices in the Fitting and Machining area in terms of pre- and post CBT curriculum. A number of possible reasons have been advanced to help explain the results obtained. The sample of students used as a basis to retest is of course a relatively limited sample, and it is desirable that a larger sample of similar students be tested to ascertain whether similar results are obtained. It is hoped that this more extensive testing will occur in the future and provide additional insights.

It should be borne in mind that there are numerous problems associated with an approach involving the testing of a similar group of final year apprentices a decade after the introduction of CBT, with the most important of these acknowledged and outlined above. However, it should also be kept in mind that this is only small part of the total research being undertaken in doctoral research by the first author in an attempt to evaluate the impact of CBT upon the Metal Trades area in NSW. To date, while the other parts of the total research project have not been published or publicly presented, it is possible to see consistent patterns emerging which tend to support the general conclusion with regard to the findings reported here. Namely, that there has been a decline in knowledge and skills of final year apprentices in this area over the past decade.

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### Note:

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