New times for mathematics in vocational education and training

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This paper will explore some of the effects on mathematics education in the VET sector where economic rationalist ideologies prevail, and hegemonic industrial values subsume educational values. In a sector which carries considerable investment of public and private funding; it may be expected that mathematics, which has a high public profile generally and with sections of business and industry in particular, should be an important focus. Somewhat paradoxically, there is an apparent lack of status.

Introduction

In terms of its relationship to vocational education and training (VET) the term *mathematics* is used in the broadest sense, encompassing all curricula which include mathematics, numerical and spatial calculations, as well as statistical components, whether officially designated by recognisable titles or incorporated into other vocational modules. There is considerable debate in some countries over the use of the term *numeracy*, but this will not be pursued here: the term will be subsumed under the broad concept of mathematics. For further discussion of the terminology of mathematics and numeracy see FitzSimons, Jungwirth, Maaß, and Schloeglmann (1996).

Kogan and Tuijnman (1995) identified several levels of educational research arising from the focus on the socialisation process, including those of "the individual learner, institutions and organisations, and the wider sociocultural, economic and political environments of societies" (p. 32). In the past I have addressed mathematics in the VET sector from the perspective of the micro- or operational level (FitzSimons, 1994a; 1994b) focusing on the activities, interactions and behaviours of the individuals themselves; and from the meso- or structural level (FitzSimons, 1995; 1996a; 1996b; 1997a; 1997b) focusing on the production and selection of knowledge as well as structure of learning relations. In this paper I will explore from the macro level the conflation of social, economic and educational values which is tending to define how, and what, mathematical competences are offered to VET students to meet perceived requirements of Australian society.

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Policy formation under economic rationalism. In Australia policy making for VET, typically of many English-speaking countries, has been characterised by political expediency and a consequent short-term outlook (Wiltshire, 1993). The management of education has shifted from experienced professionals to ministerial control (Bourke, 1994), informed by advice from career public servants. Economic rationalist ideologies seem to have provided the solution to the disjuncture between economic goals and the situations in which nations such as Australia have found themselves (Dwyer, 1995). There have been social shifts towards individual responsibility and competition, as the distinction between public and private good has been blurred (Kell, 1993); a range of social and economic agendas have been transferred onto education (Apple, 1993). The VET sector has been increasingly deregulated in the devolution of responsibility and accountability to the local level, at the same strictly controlled through legislative processes of federal and state governments who have imposed severe financial constraints.

Since the mid-1980s there has been a policy agenda to reform industry and training in the interests of improving national productivity. The policy discourse has privileged the voices of business and industry (Kell, 1992; Sachs, 1991) and marginalised practitioners and students (Anderson, 1997a; Fooks, 1996; Stevenson, 1993); policy advice on the provision of VET is sought exclusively from the privileged (e.g., ANTA, 1997). This means that the VET sector of education in Australia is informed by individuals or groups representing the interests of capital, apparently consonant with national economic (and presumably social) interests. The human capital paradigm, which has replaced that of social and personal development over the last two decades, has clearly shifted the focus of VET away from the students to industry, although such shifts appear to be cyclic (Stevenson, 1995; White, 1995).

Teachers' work in an open training market. Economic rationalist policy decisions have created an open training market for vocational education and training, with financial encouragement for private providers to compete with established institutions, albeit without sufficient thought for the ultimate structural and strategic consequences (Billett, Cooper, Hayes, & Parker, 1997; Fisher, 1993; NREC, 1997). There has been a consequent deregulation of teaching within the sector with the removal of any necessity for holding teaching qualifications, and the reduction of initiation of new teachers to an optional basis with as little as a three-day "train-the-trainer" course. Exacerbating the existing problem of a highly casualised workforce is the trend to outsourcing, resulting in the subcontracting of "outworkers" (Kell, 1997). Professional development has been devolved as a responsibility of individual providers, with deleterious effects (see, e.g., FitzSimons 1995; Kell, Balatti, Hill, & Muspratt, 1997). Under this scenario anyone with mathematical knowledge at the minimum level of the course requirements and no teacher training can be employed as a teacher or curriculum developer; the likelihood of appropriate professional development being offered, let alone taken up, remains slim.

Curricular issues. Until 1997 all VET curricula were the responsibility of national Industry Training Advisory Bodies (ITABs) and this has had serious consequences for mathematics education since there was neither a mathematics nor an education ITAB. Decisions about mathematics curricula have been distributed around a plethora of ITABs whose major focus is their particular industry grouping, hence it is unlikely that those making curriculum decisions have been informed by findings of recent research into mathematics education. The recent introduction of the National Training Framework (NTF) means that the focus is now on the training of students for particular industries, or more narrowly, particular enterprises (Anderson, 1997b), so that their mathematics education is unlikely to be considered a priority. This is of course contrary to the goals for school students (Niss, 1996) and runs counter to the NBEET (1995) report recommendation for higher education students to be supported in their studies by high quality service mathematics or statistics subjects — on an age-basis, to say nothing of developmental basis, there is an overlap of many VET students with their counterparts in other sectors and questions of equity may arise. Even on behalf of the school sector, mathematics educators (researchers and teachers) have found it difficult to be meaningfully involved in policy formation, and have resisted the subterfuge that they be used as "consultants" to give their imprimatur to decisions already taken (e.g., Ellerton & Clements, 1994). If one accepts the thesis that mathematics education can make a contribution to the well-being of a nation, important research questions are *what* mathematics is selected and *how* it may be taught. These questions, which have not been given due attention in the VET sector, must seriously address the needs and interests of both students and industry.

Competency-based education and training (CBT) was mandated as a requirement for all nationally accredited curricula, originally linked with the structural reform of industry. It was popular with administrators as a means of control over teachers and of providing accountability to the government and other stakeholders (Jackson, 1993). It was also popular with some sections of industry because of its apparent simplicity, although there has not been a large uptake of this system in Australia or the United Kingdom (Raggatt, 1997) — possibly due to the minimalist nature of the competency format, and its insistence on following national standards which are not necessarily relevant at the enterprise level. It has had the tendency to stifle or restrict creative and innovative teaching and to deprofessionalise teachers, although some teachers have managed to operate in the interstices (see, e.g., Clemans, 1997; Mulcahy, 1996). It would be reasonable to assume that the large majority of mathematics teaching practice in the VET sector follows a transmission paradigm based on the atomised series of competencies, in face-to-face direct instruction or flexible (i.e., self-paced) delivery which is frequently delivered off-campus or in composite classes on-campus.

Teaching and learning in VET. Flexible delivery is promoted in policy documents as offering improved access to education. It can be advantageous to students with good organisational and language skills, but is problematic for many other VET students (Misko, 1994). It is considered by many teachers to be merely a cost-saving device (Kell et al., 1997). Taken together with the policy of Recognition of Prior Learning (RPL) and the new NTF, the trend towards focus on assessment of outcomes rather than the processes of learning runs the risk of overlooking, even undermining, the rhetoric of lifelong learning. In order for new learning and its transfer to take place students must have a strategic framework or metatheories of learning (Billett, 1996) — strategies unlikely to develop spontaneously in a majority of VET students.

The importance of discipline knowledge has been subsumed under more visible work-related skills, although many writers (e.g., Kell, 1997) suggest that this strategy will not be appropriate for future employment scenarios where a combination of 'hard' (technical, practical) and 'soft' (strategic, communication, etc.) skills will be needed. Unlike the school sector where the focus has been on key learning areas, national curriculum and national testing in mathematics, the situation of mathematics per se in the VET sector has been virtually ignored by government policy makers, and not given any great priority by ITABs or providers such as TAFE institutes. In Victoria there are few if any remaining designated mathematics departments in TAFE; most mathematics teachers are scattered across vocational departments, and non-TAFE teachers are even more isolated. Across Australia generally there are no longer central support units for teaching and curriculum. The teaching and learning of mathematics appears unproblematic to policy makers who have engendered this situation as well as to managers at the provider level. There is no definitive career structure for a mathematics teacher who wishes to remain discipline-based; many former mathematics teachers have chosen promotion to managerial positions or left public education altogether to work in industry where they are more valued. One approach to this question of the inferior status assigned to mathematics in the VET sector may be from the perspective of mathematics as a socio-economic good.

Mathematics as a socio-economic good. Addressing the question of high status knowledge, Apple (1992, p. 420) noted that "business and industry, as well as government, place a high value on knowledge that is convertible ultimately into profits and control." He continued that mathematics was valued "not because of its beauty, internal characteristics, or status as a conservative form of human knowing, but because of its socioeconomic utility for those who already possess economic capital" (p. 423). This sentiment is reflected in a report to the Australian government which highlighted the utilitarian values of mathematical sciences, as well as a degree of self-satisfaction on the part of its authors: "Modern mathematical science is a supreme creation of the human intellect; it is also critical for economic competitiveness, and a basis for investigations in many fields" (NBEET, 1995, p. ix).

In fact, although the report's main focus was on the university sector (with one sub-section addressing the teaching of mathematics in the school sector), it totally ignored the VET sector. However, the inclusion of the VET sector would have been pertinent for the following reasons: (a) VET mathematics curricula span school and some undergraduate offerings; (b) the strongly grounded assumption of the importance of the links with industry is no less important in the VET sector, particularly for mathematics; (c) the report's emphasis on quality teaching in mathematics is equally if not more imperative to meet the particular needs of VET students; and (d) articulation between VET and university sectors is not uncommon and even encouraged by policy documents which advocate a "seamless web" of educational provision. The reasons for the exclusion of the VET sector, not an unusual occurrence in Australian mathematics education research, can only be surmised. Following Bourdieu's notion of cultural capital which sees education as a commodity, Apple (1992) suggested that mathematical and scientific knowledge function to support the unequal pattern and distribution of social and economic benefits. He argued that it may not be considered by the interests of capital to be a worthwhile investment to distribute such knowledge too widely at the expense of high status institutions such as universities which produce the technically oriented knowledge that can be utilised and controlled by them. The result, however, is that the provision of VET mathematics is apparently devalued and at the same time excluded from valuable opportunities through reports (e.g., NBEET, 1995) for public scrutiny and consideration of recommendations for improvement. I propose that this continued marginalisation of VET mathematics in government-sponsored reports and symposia, together with the conspicuous dearth of university-based research, contribute to the difficulties currently facing mathematics education in the VET sector.

Mathematical perspectives of stakeholders. In order to gain some purchase on the frame of reference for stakeholders (providers and users) who make decisions which influence the quantity and quality of mathematics education in the vocational education and training sector I investigate possible sources of ambiguity through a consideration of values, following Bishop (1988). Mathematics clearly has a high status in our society (Apple, 1992; Martin 1988/1997; Popkewitz, 1988) and yet the values which establish its power and invincibility serve to alienate or intimidate many people. Its ideological values of rationalism and objectism, separating objects from ideas and allowing abstractions to be treated as objects, have vested mathematics with power and authority but are based on a particular kind of theorising associated with modernist projects emanating from the Enlightenment. Such projects have been problematised by Walkerdine (1994) as normative, based on a limited selection of attributes reflecting the dominance of white European middle class males, marginalising all other groups. Martin's discussion of professional mathematicians supports this view of mathematics as a bureacratised, masculine domain.

The seemingly paradoxical sociological values of openness and mystery in mathematics have, in first case, been linked, albeit tenuously, to democracy and in the second to widespread feelings of ignorance and confusion. The latter could be attributed to the use of abstraction with consequent loss of contextualisation and distancing of meaning derived from perception and intuition (Bishop, 1988). Although mathematics can be used to enlighten, transcending immediate experience, it can also be used to obscure and mystify through its use of specialised knowledge and language (Martin, 1988/1997; Popkewitz, 1988). Linking mystery with control, mathematics can be used to support vested interests by providing seemingly objective and rational models, yet possibly with inbuilt biases, for predetermined outcomes (Martin, 1988/1997). Fischer (1993) observed that although mathematical models were not intended as facsimiles of reality, they can in fact be used to construct new social realities such as in economic and social planning.

Although the values of control and progress underpinned by technology have resulted in improvements in many aspects of society this has not been unproblematic. Mathematics has provided a tool for gaining control over physical and social environments, but humans are now entrapped in a technological society. Control is exerted dialectically with social perceptions of mathematics researchers and privileged interests of sponsors operating in the direction and utilisation of results of mathematical research (Martin, 1988/1997). However, most people are unaware of the subjective, systemic side of mathematics inherent in humans, thereby allowing the domination of the objective, controlling and explanatory side (Fischer, 1993).

Each of these six values, valorised by mathematicians and their supporters, can engender negative responses among other members of the community (who possibly hold simultaneously conflicting views when assuming different social roles). Whether held consciously or unconsciously, these values must impact on the decisions made about mathematics in the VET sector.

Conclusion

Since the mid-1980s Australian governments have embarked on policies informed by economic rationalism to reinvent the VET sector as a corporatist entity — devolving responsibility for management to the local level, and for matters relating to curriculum, assessment and credentialling to representatives from business and industry. In the formation of an open training market, as well as in the imposition of the competency agenda, governments have conflated social and economic purposes with those of education (Apple, 1993; Sedunary, 1993).

With an overall enrolment of 1.7m students the sector carries considerable investment of public and private funding, with only a modest amount of corporate support (Anderson, 1997a); it may be expected that mathematics, which has a high public profile in society generally, and with sections of business and industry in particular, should be an important focus. Its apparent, but somewhat paradoxical, lack of status can be explained by a range of factors, stemming from political economic rationalist ideologies, as well as ambiguous values ascribe to mathematics by decision makers. The sector's emphasis on industrial values have assigned a pre-emptive good to education and training (Stevenson, 1995), privileging the perceived interests of business and industry while effectively silencing the voices of teachers. The residual status assigned to VET mathematics by government, industry, and university research arms has exacerbated the situation. These are, indeed, new times!

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