Chapter 6

Why improved formal teaching and learning are important in technical and vocational education and training (TVET)

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Contents

1 Introduction

The nature of the relationship between education and the economy has always been contentious, but not so in the case of technical and vocational education (TVET). Here the general maxim is that the closer the relation between TVET institutions and actual workplace practices, the greater the relevance of TVET curricula and the better the chances of graduates of becoming employable. This assumption has had a significant impact on considerations about the nature of knowledge transmitted in TVET curricula, as well as on the qualifications required of TVET lecturers, instructors and trainers. However, current debates on education and training as a 'universal good' and especially the pressing need for access and equity on the one hand and higher-order excellence and innovation on the other, are necessitating a reconsideration of long-held assumptions about both the nature and quality of TVET.

The argument of this paper is that access and equity are not necessarily at the one end of a continuum of learning and occupational progression, with higher-order excellence and innovation at the other end. These two constructs also do not stand in a dichotomous relation, with the one achieved at the expense of the other, as cynics might claim. Both are crucial for human development and for building a country's economic base, and yet the relationship between them is more complex than is often acknowledged. It is for this reason that the paper makes the claim that, contrary to the common wisdom that proximity of curricula to the workplace is the 'golden wand' of successful TVET, improved formal teaching and learning are as important in TVET as they are in all other educational domains.

The paper starts with a brief review of some of the debates about the changing nature and scope of TVET and its institutionalization. This provides a context for considering why knowledge differentiation rather than generic versions of skill needs to be the basis of TVET curricula. Within this frame the paper then considers the idea of vocational pedagogy, to argue that formal teaching and learning in TVET institutions need to be strengthened if there really is to be a meaningful relation between various TVET objectives.

2 The changing nature of TVET

TVET is an ambiguous term which contains within it both a higher and lower end of an educational hierarchy. From a British perspective, Wolf argues that vocational education:

> Does not mean a medical or veterinary degree; or a post-graduate law school course; or taking one's accountancy examinations while working for one of the big City accounting firms. It does not even mean nursing or teacher training. 'Vocational education', instead refers to courses for young people which are offered as a lower-prestige alternative to academic secondary schooling and which lead to manual craft and, more recently, secretarial jobs. 'Technical education' slots into the hierarchy above vocational and below academic; and leads in theory, to the technician jobs which increased in number during the twentieth century.
>
> (Wolf, 2002, p. 58)

The three-tier distinction between vocational, technical and academic education remains firmly in place in most countries but at the same time it is claimed that the so-called knowledge economy now requires all students to develop higher-order skills of reasoning, conceptual problem-solving and communication, leading to what Wolf, (2011, p. 20) describes as a more or less universal 'aspiration to higher education'. This requirement is expressed as:

> The ability to analyse complex issues, to identify the core problem and the means of solving it, to synthesize and integrate disparate elements, to clarify values, to make effective use of numerical and other information, to work co-operatively and constructively with others and, above all, perhaps, to communicate clearly both orally and in writing.
>
> (as cited in Ball, 1985, p. 232)

Somewhere near the middle of the hierarchy we could insert a more overtly vocational prescription for what is required in the world of work of the future. Australian research argues that work-ready students should have:

- The knowledge and skills they need for work;
- Adequate language, literacy and numeracy skills, and foundations skills;
- 'Green' skills needed for a sustainable economy and society;
- Technological skills;
- Employability skills; and
- The knowledge and skills they need for further learning (Wheelahan and Moodie, 2010, p. 15).

At the bottom end, the youth labour market that is premised on a direct transition from school to work has all but collapsed in the last decades (Young, 2008). It is argued that the rearrangement of labour market entry by higher levels of technology, and shifts from manufacturing to service industries, have led to a decrease in apprenticeships, traditionally a highly effective route into stable employment for young people in many countries (Kraak, 2008; Wolf, 2011). It is also argued that entry into existing apprenticeships increasingly requires higher general academic qualifications, which are more often available to middle-class than to less advantaged youth (Kupfer, 2009).

Even though there has been an increase in the provision of lower-level vocational qualifications that ostensibly offer access to job and career pathways, these are often described as dead-ends that lead many young people in advanced industrialized countries to 'churn' or 'swirl' between education and short-term or casual jobs in an attempt to find educational opportunities that offer real chances of academic progress or a stable, paid job, and often finding neither (Grubb, 2006; Wolf, 2011). In less economically advanced countries the detrimental impact of poverty on educational outcomes remains a critical challenge which, when linked to high unemployment and limited economic growth, provides young people in these countries with even fewer opportunities for work or further study (Van der Berg, 2011).

It is thus not surprising that the figures for young people neither in employment nor in education and training (NEETs, as they are called) are on the rise in all countries, at least in part because employers tend to favour older applicants with higher-level qualifications, in a context of rising unemployment. The Organisation for Economic Co-operation and Development (OECD) (2010) reports, for instance that, by mid-2010, in the twenty-six countries for which information was available, 12.5 per cent of youth aged 15–24 were NEET, up from 10.8 per cent in 2008. This represents 16.7 million young people, of whom 6.7 million were seeking work at the time and 10 million had given up looking. In a country such as South Africa, where links to the developed world, through aspects of an advanced economy, coexist with the majority of people having access only to the most basic infrastructure, coupled with a huge income gap between those who live in poverty and those who live in affluence, the figure for the 18–24 NEET group is calculated as approximately 2.8 million. This results in a dismaying figure of 42 per cent of the approximately 6.8 million young people in this age cohort being neither in employment nor in education and training (Cloete, 2009).

Almost conversely, both the economic ‘pull’ of higher-level qualifications and the ‘push’ into education as a result of a lack of jobs are contributing to massification trends in higher education (Wolf 2011). In this scenario ‘access and equity in education’ and ‘education for higher-order excellence and innovation’ become the ends of a supposed continuum in which the space between the two ends is often rather hazy in terms of delivery potential. Educational systems endeavour to achieve both purposes through institutional differentiation, so we need to consider where TVET fits into a differentiated education and training system.

3 TVET institutionalized

TVET is linked to a wide range of physical institutions, such as secondary and in some cases even primary schools, public and private further and higher education, and training colleges and universities of both a general and specialist nature. It is thus helpful to examine current debates around institutional differentiation to determine whether it is possible to isolate distinctive features of TVET at the level of educational institution, or whether its distinctiveness lies at the level of programme or course.

Differentiation is described as the process through which new entities in a system emerge. Diversity is the accompanying term which denotes the variety of entities in a system at a particular time (Van Vught, 2007, p. 1). Arguments in favour of diversified systems point out, among other issues, that such systems open up access to students from different educational backgrounds, allow for multiple entry and exit points, respond more effectively to labour markets, and permit the crucial combination of mass and elite higher education on which all countries depend (Birnbaum, as cited in Van Vught, 2007, pp. 5–6). However, there are also studies that argue that, instead of differentiation, higher-education systems are in reality characterized by dedifferentiation and decreasing levels of diversity through 'academic drift', which creates a tendency towards uniformity (Grubb, 2006; Van Vught, 2007).

Codling and Meek's (2006) study of universities in Australia and New Zealand points to 'mission stretch'. This refers to two distinct if related processes, academic drift and vocational drift, which result not in institutional diversity, but rather in institutional convergence. Their study shows that, when these trends are generalized, the traditional universities are exhibiting vocational drift by adopting more applied missions, developing active partnerships with industry and the new professions, offering more overtly vocational qualifications, generating more applied research funded by industry, and becoming more enabling in their admission policies to encourage non-traditional learners. Universities of technology are exhibiting academic drift by appointing more university-trained and experienced academic staff, adjusting their organizational cultures to be more academic, shifting enrolment patterns to include more school leavers, broadening and increasing their research focus, and adopting much of the symbolism and nomenclature of the traditional university (Codling and Meek, 2006, p. 41).

The tendency towards institutional convergence is often reinforced by a requirement of central governments that diversified systems be coordinated according to a single set of criteria (Bleiklie, 2003). Convergence may well be advanced by the role that national qualifications frameworks (NQFs) are playing in the reform initiatives of many countries towards greater transparency, coherence and permeability between education and training subsystems and the removal of barriers between TVET and higher education (CEDEFOP, 2010). There are also well-documented critiques of this logic (Allais, 2010). The ranking of higher education institutions according to a single set of indicators is a further contributing factor.

Referring to developments in both Europe and the United States, Scott (2006) brings a historical perspective to the debates when he argues that institutional stratification was the major mechanism that produced stable state-mandated differentiation in the twentieth century; in other words, the building-up of layers of institutions with distinctive missions. In the twenty-first century, an increased emphasis on the 'market' is producing far more volatile patterns of differentiation. This happens through mergers and acquisitions; strategic alliances and network relations between institutions; and perhaps most commonly, through different forms of internal differentiation. In the policy trajectories of developing countries such as South Africa, Kraak (2001) similarly draws a distinction between a 'hard-stratified' route of institutional differentiation and a 'soft-stratified' route of programme differentiation.

While many of the above debates refer mainly to the university sector, we see similar internal differentiation developments in the college sector. Grubb (2006) provides an overview of the 'active transfer programs' in the United States, between community colleges that offer associate degrees which can replace the first two years of four-year degree courses offered by second-tier universities (often called state colleges or regional universities). In certain instances, universities themselves offer these associate degrees, while in other instances colleges offer baccalaureate degrees, which were traditionally in the university domain.

Green and Lucas (1999) describe a blurring of boundaries between further and higher education in the United Kingdom. In South Africa, Stumpf and colleagues (2009) offer proposals for increasing the mandate of further education and training (FET) colleges through universities franchising colleges to offer certain higher-education programmes on their behalf, or through colleges being able to offer certain higher-education programmes in their own right.

4 Knowledge differentiation

The 'soft-stratified' route of programme differentiation is no less complex. Apprenticeship, for centuries the main source of formal vocational training for crafts and trades (Wolf, 2002, p. 58), was the forerunner of formal TVET programmes. TVET, in its turn, took on different forms which coincided with the timing and pace of industrialization in different countries (Deissinger, 1994; Green, 1995). Referring specifically to nineteenth-century England, Green argues for instance that:

> Technical education had been cast in a mould that subsequent legislation would find hard to break. Growing up as an extension of the apprenticeship system and reliant on employer initiatives, it developed in a fragmented and improvised manner: perennially low in status, conservatively rooted in workshop practice and hostile to theoretical knowledge, publicly funded technical education became normatively part-time and institutionally marooned between the workplace and mainstream education. A century later we have still not overcome the deep divisions between theory and practice and between academic knowledge and vocational learning which were first entrenched in these nineteenth-century institutional structures. Nor, would it seem have we quite outgrown the voluntarist reflex which gave rise to them.
>
> (Green, 1995, p. 139)

Much of what Green describes as indicative of nineteenth-century technical education remains today. What has changed in the twenty-first century, however, is the relationship between theoretical knowledge and work.

> The knowledge society means that each occupation and its attendant knowledge base will increasingly be under pressure to augment its quantum of conceptual knowledge, to become at least partly mental. This is because generalisable innovation relies on conceptual knowledge … and it is this kind of innovation that the global economy prizes most at all levels of the division of labour.
>
> (Muller, 2009, p. 16)

A conceptual knowledge base may be the new requirement for TVET, but technical, vocational and professional education always face 'both ways' (Barnett, 2006); towards the non-empirical world of ideas and concepts as well as towards the empirical world of practice and experience. In these educational fields the curriculum thus always transmits knowledge-based practice, even though this relationship is often obscured by the reduction of all types of knowledge to skill sets. Such reductionism is characteristic of the ideological shifts towards outcomes-based education that are favoured by progressivists in schools as well as by advocates of NQFs (Allais, 2006; Muller, 2001). In 'skills' approaches, knowledge becomes invisible and fundamental epistemological issues are ignored. Young (2006) goes so far as to argue that this has happened throughout the history of TVET.

At the level of programme differentiation, the epistemic logic of the curriculum, which refers to 'requirements for teaching and learning posed by the form of the knowledge to be transmitted' (Gamble, 2004a, p. 176), requires consideration of the knowledge base on which qualifications are premised. In order to do so, we briefly consider the work of a number of theorists in this field.

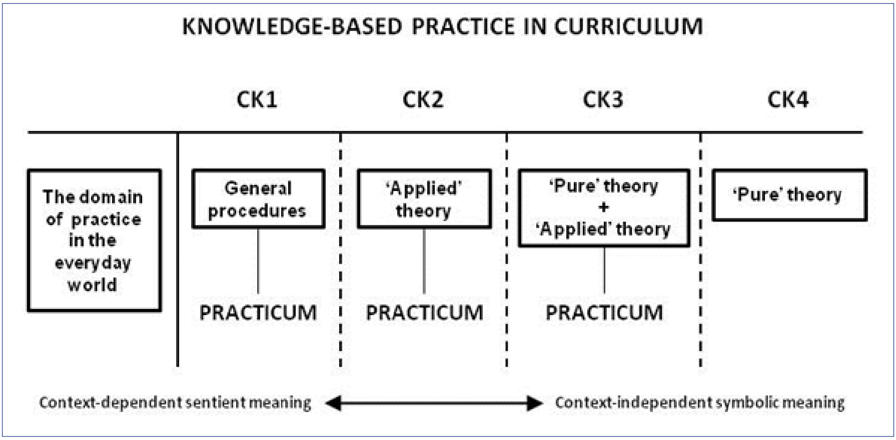
Bernstein (1996, 2000) distinguishes between three forms of knowledge which, according to their focus and social organization, provide the basis for performance-based curricula and pedagogies. He refers to these forms of knowledge as 'singulars', or what is commonly known as disciplinary knowledge, such as physics, chemistry, history, economics and psychology; 'regions', where disciplines combine to respond to a particular field of external practice, most commonly in professional fields such as engineering, medicine and architecture; and generic modes, produced by a functional analysis of 'what is taken to be the underlying features necessary to the performance of a skill, task, practice or even an area of work' (Bernstein, 2000, p. 53). Beck and Young (2005) argue that it is this last category, which they term 'genericism', that is driving curricula in many fields ever closer to the concreteness of 'the world', or what Sohn-Rethel (1978) refers to as a 'context of human action' where meanings derive from concrete events or experiences that have actually happened in a specific time and place. This means, by definition, that curricula also tend to be driven farther away from a 'context of thought' (Sohn-Rethel's corresponding term), where meanings exist only in abstract or symbolic form, independent of the time–space context of their production.

Schein (1972) identifies three separate but related elements of the knowledge base of various professions, which are related to Bernstein's concept of disciplinary regions. He argues that all professional practice rests on an underlying disciplinary base, in which the disciplines may be more or less convergent. Anatomy, biochemistry, physics and mathematics are convergent disciplines in medicine, for instance, while professional fields such as social work or teaching rest on more divergent disciplines such as various branches of psychology, history, philosophy, anthropology and sociology. A professional field also has an applied theoretical component, from which many of the day-to-day diagnostic procedures and problem solutions are derived. Third, a professional field has a skills and attitudinal component (the 'practicum' or 'work-integrated learning' component of the curriculum). These three components vary in terms of their form, sequence and timing, but they are all present in some form in the curricula of professional fields.

Using the above vocabulary, the schematic diagram (Figure 1) shows various types of relation between a knowledge base and a form of practicum in curriculum. The various forms of curriculum knowledge (CK) are labelled CK1 to CK4, to signal that a particular curricular type should not be associated with a particular kind of institution, or with a particular professional, technical or occupational field of practice. To do so would be misleading, as we have already noted the permeability that currently exists between the types of programmes offered by different institutions. Fields of practice also have stronger or weaker disciplinary foundations which predispose them to a certain type of curriculum. Moreover, any one field of practice contains a range of professional, paraprofessional, technical, skilled and semi-skilled occupations, which bring the forms CK1 to CK3 into play at different levels of specialization. It is only in type CK4, usually associated with academic schooling and with formative undergraduate and academic postgraduate studies, where the conceptual base of the curriculum operates on its own without direct reference to a form of empirical practice.

What the four types have in common is that the knowledge base in each operates at a higher level of generality than the specificity of a particular instantiation of practice in the everyday world of professions and occupations.

Figure 1. Curriculum types in the knowledge-practice curriculum



Source: Gamble (2011).

The dotted lines between the different curriculum types indicate that there is no natural progression between curriculum types. A student who achieves success in CK1 is not necessarily going to achieve success in CK2, CK3 or CK4. Neither is it a foregone conclusion that success in CK4 means that students will automatically achieve success when they cross over to a practice-oriented curriculum. Educational progression from one curriculum type to the next is thus not just a question of formal institutional access; it is crucially dependent on epistemological access. As Morrow put it succinctly:

> Formal access is a matter of access to the institutions of learning, and it depends on factors such as admission rules, personal finances and so on; epistemological access, on the other hand, is access to knowledge. While formal access is important … epistemological access is what the game is about.
>
> (Morrow, 2007, p. 2)

To show the differences between knowledge bases, we turn to some examples of NQF-based qualifications. The knowledge base of a CK1 curriculum type can be illustrated by an extract from a vocational qualification in Clothing, Textiles, Footwear and

Leather (CTFL) Mechanician Processes, registered as a certificate on the South African NQF (at level 4). Exit level outcomes include the following:

Table 1. A qualification with a general procedural knowledge base, at NQF level 4

On achieving this qualification, a learner is able to:
• Monitor the use of raw materials, lubricants and chemicals when maintaining machines and equipment, interpreting data, evaluating information, keeping records and solving under and over use problems related to materials.   • Maintain and use a range of hand or power tools understanding the technology related to such tools and adapting to situations that occur during maintenance and repair procedures.   • Record quality matters and maintain a quality system as it applies to maintenance recognising areas of poor quality and then communicating action to rectify areas of poor quality.   • Monitor waste and record waste related statistics.

Source: http://regqs.saqa.org.za/index.php. This is an extract from a full unit standard

In this qualification the 'monitoring', 'maintaining' and 'recording' activities are of a procedural nature, and they take their sequential or stepwise logic from the empirical domain of actual workplace practice. External 'adequacy-to-context' (Muller, 2009, p. 216) is the main selection principle, and there is a close relation between the general procedures stated in the qualification and specific everyday practice. The knowledge component is not stated explicitly but is assumed to be embedded in the competence to be achieved. As Allais argues in her critique of this type of curriculum logic:

> The emphasis is on competence statements in the learning outcomes; knowledge is relegated to a category called 'essential embedded knowledge', which is supposed to mean knowledge that underpins the particular competence that has been specified in the learning outcome. Knowledge cannot, in this approach, be the starting point; the 'essential embedded knowledge' is derived from the outcome', and not stipulated as part of a

> body of knowledge worth mastering …. Learning programmes should not be designed based on the internal requirements or logic of a knowledge area; instead knowledge areas should be selected on the basis that they can lead to the competence in question, or that they 'underpin' it.
>
> (Allais, 2006, p. 25)

When we move to CK2, CK3 and CK4, the knowledge bases look very different. Table 2 compares extracts from two South African curricula in physical science which were developed prior to the introduction of the South African NQF but were deemed to be equivalent at NQF level 4. Physical Science Higher Grade (Curriculum A) is the culmination of three years of study in a senior secondary school. Engineering Science N3 (Curriculum B) refers to an eleven-week (or trimester) technical/vocational course offered by a South African FET college as part of the apprenticeship system. The example makes it clear how distinctions between 'pure' and 'applied' theory are achieved through differences in selection and sequencing of content, level of cognitive demand in examination questions and time allocated to instruction.

Table 2. Comparison of content coverage in two NQF level 4 science courses

PHYSICS	
Curriculum A. Physical Science (Higher Grade)	Curriculum B. Engineering Science N3
Bodies in Motion: Newton's 1st law of motion, Newton's 2nd law of motion, Newton's 3rd law of motion	Bodies in Motion: Newton's 2nd law of motion
Newton's Law of Universal gravitation, projectile motion (up and down)	
Concept of friction	Friction: Static & kinetic friction, horizontal and inclined planes
	Moments: Turning moment for constant motion, levers and lamina, beams
(Heat: specific heat capacity, transfer of heat covered in Grade 10)	Heat: specific heat capacity, transfer of heat, heat value of a fuel, efficiency, expansion and steam
	Hydraulics: hydraulic presses, work done against a pressure
Electrostatics: electricity at rest, force between charges, electric fields, quantization of charge	
CHEMISTRY	

Curriculum A. Physical Science (HG)	Curriculum B. Engineering Science N3
(Covered in Grade 10)	Elements: constituents of matter, periodic table, metals and non-metals, structure of the atom
Reaction rates and chemical equilibrium, energy of reactions, dynamic equilibrium, equilibrium constant, change of state of equilibrium, equilibrium in solutions, some industrial and other applications	
Acids and bases: dissociation of water, pH (quantitative), models for acid and base, acid-base titrations	
Redox reactions: definition in terms of gain or loss of electrons, identifying oxidising and reducing agents	Redox reactions (brief introduction) and corrosion
Electrochemical cells: copper-zinc cell, electrolysis and electroplating	Electron transfer: formation of ions, brief definition of electrolysis and electroplating
Half-cell potentials: table of redox half-reactions and applications, selection of reference electrode, calculations of potential difference	
Organic chemistry: definition, structure, nomenclature, hydrocarbons, alkyl-halides, alcohols, carboxylic acids	

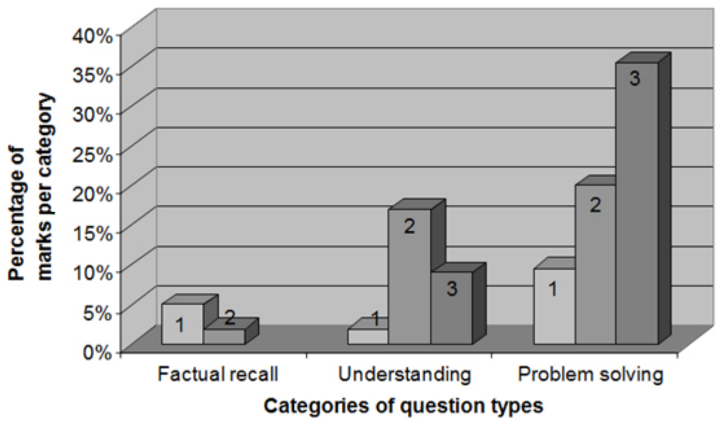
[This is an extract from the full table presented in Umalusi, 2006, 53 – 55.]

Both types of curriculum in Table 2 are 'theoretical', but Curriculum A represents what could be called 'pure' theory, selected and arranged in terms of an internal 'adequacy-of-sequence' logic (Muller, 2009, p. 219) which has a certain necessary congruence with the vertical spine of the parent discipline (Muller, 2009, p. 16); in this case the parent disciplines are physics and chemistry.

Curriculum B also represents conceptual knowledge, but the selection and sequencing of knowledge are driven purposively and pragmatically by a direct relation to aspects of engineering practice ('applied' theory). In Curriculum B certain content areas are omitted entirely. Where there is content similarity with Curriculum A, there are notable differences in both depth and range. Curriculum B, however, covers a greater number of specifically industrial applications. The sub-report (undated) on research comparing these curricula on which the overall report is based (Umalusi, 2006), warns that the dearth of chemistry-related content in Curriculum B will catch up with students should they attempt to study further in a science direction at higher education level.

The difference between the two types of curricula is even more pronounced in the categories and levels of cognitive challenge encoded in the examination questions (see Figure 2).

Figure 2: Curriculum A - Physics Higher Grade examination mark breakdown



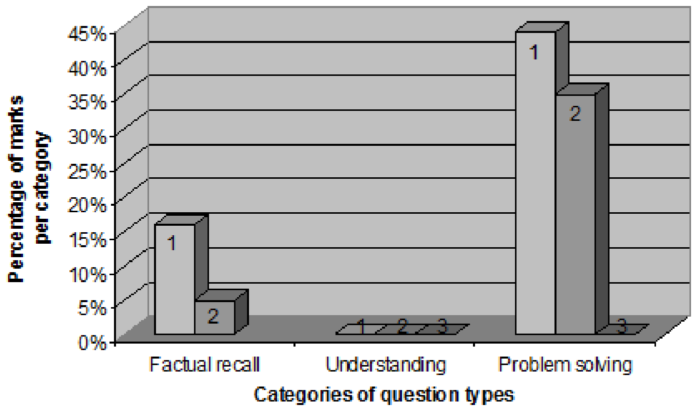
Source, Umalusi (n.d., p. 6).>

In Curriculum A, 82 per cent of the questions required medium and challenging levels of understanding and problem solving, with only 7 per cent of questions requiring simple or medium factual recall.

When we turn to Curriculum B the situation looks entirely different: see Figure 3.

The N3 Engineering Science examination contained no questions which probed understanding of concepts or principles. All questions fell into either the factual recall or problem-solving categories. The examination contained no questions in the problem-solving category at level 3 (the challenging level). The exam mostly tested application of procedures (level 1). Of the examination marks, 60 per cent were allocated to questions at cognitive level 1 (simple), with the remaining 40 per cent at level 2 (medium).[1]

Figure 3. Curriculum B - N3 Engineering Science examination mark breakdown



Source, Umalusi (n.d., p. 6).

These three examples were chosen not because they are representative of types of curricula in all countries, but because they mark out the curriculum terrain we commonly describe as TVET. In terms of the typology presented earlier, they illustrate what is possibly the knowledge base of lower and middle-level vocational education at the access and equity end, and at the other end, the technical and professional knowledge base required for further study that will lead to higher-order excellence and innovation. In terms of accreditation parity, all three curricula are pegged at level 4 of the South African NQF. What is clear, however, is that their knowledge bases inform practice in very different ways, so that one form of knowledge does

1 When the author discussed this graph with college lecturers they conceded that many of the questions under 'problem-solving' actually belonged in the 'factual recall' category, in that the problem-solving questions referenced rehearsed solutions which students had practised many times in class. The examination thus appears to call for novel problem-solving but the responses given are routinized and procedural in nature.

not automatically lay the foundation for the next level, in terms of the CK1 to CK4 knowledge types shown in Figure 1.

This is the dilemma of teaching and learning in TVET; a dilemma that is masked by the ubiquitous 'skills' discourse.

5 What then is vocational pedagogy?

'Learning by doing' is characteristically the way in which vocational pedagogy is described, but such a simplistic understanding obscures the fact that there is no one definitive notion of vocational pedagogy, just as there is no one idealized notion of a TVET teacher (Wheelahan, 2010).

In order to think about TVET teaching, we again need to turn to the master–apprentice relationship,[2] which provided apprentices with an opportunity to work under the close supervision of an artisan or journeyman, in all facets of a trade, as the first prototype for what could be called a vocational pedagogy. It is also this pedagogy that is often described as a 'mystery' (Donnelly, 1993, pp. 42–43) or a 'secret' (Singleton, 1989, p. 29), to indicate a modelling pedagogy without discursive elaboration. A good example is Nielsen and Kvale's (1997, p. 134) description of a master car mechanic in North Jutland who was known for two things: that his apprentices became the best car mechanics in the region and that he hardly ever said a word to them. Gamble's (2004b) study of craft pedagogy in cabinet-making describes the 'teaching' observed as a largely unpedagogized form of modelling which takes its logic from the relation between purposeful activity and its organization (work), materials and tools (as originally described by Marx, 1865–6/1976, p. 284). It is this interrelationship that constitutes the context of specialization, both at the point of production in the workplace itself and at the point of in-job craft reproduction practices. Artisans hold the knowledge of their trade as an integral part of a collective craft identity, so that initiation into a craft or trade is as much a social identity formation process as it is a process of building technical capability.

2 The terms 'master' and 'journeyman' are used here in a non-gender-specific way.

The history of industrial development shows how, in the late nineteenth century when technology started to draw more strongly on general scientific principles (Layton, 1984), a knowledge base that was deemed a 'mystery' was no longer considered adequate for the preparation of artisans. Increased mechanization resulted in a more specialized technical division of labour which often deprived apprentices of exposure to all aspects of a trade. In order to establish a basis for understanding the scientific basis of technology, it became necessary to introduce mathematics and science into the apprenticeship curriculum, especially for the engineering trades. From this time onwards we find traditional work-based apprenticeships shifting to a 'theory–practice' combination, with technical institutions, as the forerunner of technical colleges, offering theoretical instruction in mathematics and science on a day- or block-release basis or through evening classes to apprentices indentured under formal contracts of apprenticeship. Referring to the United Kingdom, Young (2006) terms this a knowledge-based or discipline-based approach to vocational preparation. It was assumed that a scientifically grounded knowledge base would enable apprentices to engage in the kind of problem-solving required by more advanced levels of technology, in combination with tacit knowledge and competence that could only be acquired through practical work. The French trade schools of the nineteenth century offered a combination of theoretical and practical training, as it was not assumed that years of serving as an apprentice, very often doing the same thing over and over, was an adequate proxy for systematic practical training (Green, 1995, p. 137).

We therefore see a shift from the master-artisan as trainer at the point of production, to a combination of teacher in a classroom and instructor in a college-based workshop.

While these systems continue in many countries, especially in technical education, in an increasing number of countries there has been a shift to competency-based modular training (CBMT), or what Young (2006) terms a standards-based or outcomes-based approach to vocational qualifications. Standards-based vocational preparation is premised on a detailed specification of learning outcomes. Learning materials include practical exercises as well as interim competency tests. Trainees work at their own pace, and when trainees are confident that they have reached the required standard, they approach the assessor for assessment, which proceeds on a 'competent'/'not yet competent' basis (Gamble, 2000, p. 30). In a CBMT system the role of the technical trainer changes from instructor to coach or facilitator of learning and, most importantly, to assessor.

While standard-based curriculum approaches consistently favour 'learning as outcome' over 'learning as content', they simultaneously foreground 'learning as process' and a deeper understanding of individual and group learning. Theoretical justification for the elision of two seemingly dichotomous educational positions was found, among other places, in the influential work of Lave and Wenger (1991), who emphasized a 'learning curriculum' over a 'teaching curriculum'. A learning curriculum is described as 'a field of learning resources in everyday practice viewed from the perspective of learners' (1991, p. 97). The focus is on 'situated activity' within a 'community of practice' (Lave, 1993). The workplace is regarded as the prime site of learning, but the role of the 'master as pedagogue' is 'decentered' (Lave and Wenger, 1991, p. 94). The work of Engestrom and Vygotsky, under the broad banner of sociocultural activity theory, was also used to argue for a refocusing of attention on learning within active processes of knowledge construction, in an attempt to broaden the narrow focus of standards-based approaches to learning (Guile and Young, 1998, 1999).

Over time, initial endorsement of the potential of social practice theories began to give way to a questioning of the implications of radical shifts to a 'learning curriculum'. While generally recognizing the value of learner-centred approaches, Fuller and Unwin (1998, p. 159), for instance, raised concerns about the downplaying of the teacher's role. Young (2000) similarly criticized the model of curriculum that results when all knowledge is treated as embedded in specific contexts. In Young's view, such a model privileges the meanings that people create for themselves and ignores the fact that many of the meanings that need to be acquired have already been 'pre-constructed' elsewhere (Young, 2000, p. 10). In later work, Young (2002, 2006, 2008) has argued consistently for the continued importance of knowledge in curricula, and has cautioned designers of vocational programmes to 'take the question of knowledge seriously' (2008, p. 171).

Such critiques are a long way from our initial formulation of vocational pedagogy as 'learning by doing'. In TVET 'doing' will always retain centrality, but what we have seen is that an adequate knowledge base on which rest 'doing', 'making', and 'creating', as different forms of practice (Gamble, 2009), has become a crucial curriculum requirement – hence the call for improved teaching and learning in TVET. It is within this complex understanding of what vocational pedagogy entails that we examine some of the implications for teacher competence.

6 Implications for teacher competence

Debates around teacher competence in TVET indicate trends towards greater professionalization of the teaching cadre (Cort et al., 2004; Skills Commission, 2010; Young, 2008). It is argued that TVET teaching is becoming increasingly diverse and that workplace or industry experience, while a necessary and important criterion for VET teaching, is no longer sufficient on its own. The deepening of the knowledge base on which TVET teaching rests in terms of both content engagement and pedagogic engagement is the basis for moves towards increased professionalization.

In simple form, the basis of TVET teaching can be schematized as the interrelation between three foundational dimensions:

- Formal subject or technical knowledge,
- Pedagogic expertise,
- Practical workplace experience.

Despite moves towards professional standards in many countries, there is no uniform developmental trajectory to ensure that all three dimensiosn are in place and interconnected. We briefly review current developments.

6.1 Subject/technical knowledge base

There is a marked lack of international consensus about what counts as an entry-level academic or subject specialization qualification. In most countries there are different qualification pathways for the teachers of vocational subjects in TVET institutions, with the requirement of a bachelor's degree as the main distinguishing feature between the different tracks. Teachers of general subjects in TVET institutions tend to follow the same degree qualification pathway as teachers in academic schools. However, teachers of vocational subjects are not necessarily required to be qualified at degree or higher-diploma level in their subject specializations. A recent United Kingdom enquiry into teacher training in vocational education recognized that vocational lecturers have been, and continue to be, considered 'second class' in relation to school teachers, and this despite policy-makers now considering vocational teaching to be a 'core profession' in the knowledge society (Skills Commission, 2010, p. 8). The key conclusion of this enquiry points to the 'need to converge the two separate teacher training regimes that currently exist for teachers of academic subjects in schools and those of vocational subjects in further education and the post-compulsory sector' (2010, p. 9).

In contrast to this, a European Centre for the Development of Vocational Training (CEDEFOP) report, based on ten case studies which each describe a single 'case of good practice' in six different countries (Denmark, Finland, Italy, the Netherlands, Norway and Portugal), concluded that 'in many countries in Europe initial qualification as a vocational teacher requires a higher education degree followed by teacher training that is regulated at national level. In some countries a nationally-recognised vocational qualification is recognised in place of a higher education degree' (Cort et al., 2004, p. 23).

Compensation for unevenness of regulation of formal subject matter qualification requirements in vocational subjects is, to some extent, sought in an increasing requirement for some form of pedagogic qualification.

6.2 Pedagogic knowledge base

Specifications for the pedagogic knowledge base of TVET teaching are highly varied. Although acknowledging that, especially at instructor level, educational knowledge is lacking in terms of linking theoretical knowledge to operational expertise (CEDEFOP, 1990, pp. 7–8), the literature tends to be dominated by discussions about increasing role diversification and role expansion in terms of new sub-specializations such as learning needs analysis; the planning and management of learning systems at operational and strategic level; learning design; distance learning; multimedia teaching; counselling and specialized learning support; integrated communication technology (ICT); inclusive education; ecological awareness; evaluation, audit and quality assurance; labour market analysis; partnership creation and networking – to name but a few. In addition the target groups of TVET are growing increasingly diverse in language, age, employment status, educational background and learning preparedness, which similarly leads to educational role specialization (Cort et al., 2004; Grootings and Nielsen, 2005; ILO, 2010; Skills Commission 2010; Wheelahan and Moodie, 2010; Young and Guile, 1997,).

A range of entry teaching qualifications are described by the sources cited above, ranging from postgraduate teaching qualifications and associate degrees to various levels of certificates and diplomas. There is a tendency, especially in certain Anglophone countries, to base mandatory teaching entry requirements on low-level, standards-based qualifications in order to attract industry experts to VET teaching. In other countries, the initial entry bar is being raised. Cort and colleagues (2004, p. 40) note, for instance that in many European countries, reform of TVET systems is changing the ways in which teaching is organized, with the result that some teachers are no longer formally qualified to teach with their existing teaching qualifications.

Where VET teacher professionalization is taking place, initial entry into VET teaching is often undertaken by technical universities/universities of technology that can offer the technical subjects which will be taught; or, as in the United Kingdom, premised on university–college partnerships or on teacher development provision offered by colleges themselves. In both the latter instances specialist vocational pedagogy is the remit of colleges.

At academic universities, postgraduate study in education for TVET teachers and those who provide curriculum and academic leadership focuses on various forms of research, comparative policy analysis and deepening of theoretical bases for understanding curriculum and pedagogy. Moos and colleagues (2006) also argue that that the general 3+2+3 structure of higher education introduced by the Bologna process (that is, three years for a bachelor's degree, two additional years for a Master's degree and three years for a Ph.D.) has facilitated the integration of TVET teacher education into the general system of education in many countries.

6.3 Practical workplace experience

'Loss of qualification' as a result of remoteness from the workplace is an ongoing lament in the literature consulted. This relates both to those who acquired their specialism through tertiary education and those who entered VET with considerable prior work experience but who eventually became out of touch because they did not have regular contact with the world of work. Regular contact between TVET institutions and workplaces, 'twinning' arrangements, involving industry and unions more closely in defining teachers' future roles, work placements, internships and practical training periods in companies are among the recommendations most frequently cited.

6.4 Is this 'good enough'?

Of the above three components of expertise, practical workplace experience continues to dominate as the central tenet of the TVET teacher's repertoire, and it is perhaps a retrospective yearning for operational expertise gained at the point of production in work itself as the basis for vocational teaching and learning, that foregrounds the need for practical workplace experience. In this regard, the spectre of the 'master-artisan as pedagogue' who 'initiated apprentices into the theory and practice and other mysteries associated with a particular occupation' (Aldrich, 1999, p. 15) clearly still looms large over our understanding of TVET teacher competence. There is, however, one big difference. While it was noted earlier that craft pedagogy is largely unpedagogized and transmitted through modelling practices rather than through instruction informed explicitly by educational theories, we see in contemporary prescriptions for TVET teaching what could almost be termed as an over-compensation for the tacit modelling aspect of craft pedagogy. This is evidenced by an insistence that workplace experience should be amplified by the use of 'cutting-edge' technology and every available form of educational innovation in teaching methods.

In addition, the drive towards the corporatization of TVET-oriented institutions through management by quality assurance indicators undoubtedly promotes 'generic' forms of teaching that can be captured by a single set of indicators across all subject areas. Under these conditions, references to systematic scientific knowledge being the basis of teacher competence are more often about parity of esteem and remuneration between vocational and academic teachers than about qualifications being viewed as binding on all teaching, whether at the 'access' or the 'innovation' end of TVET objectives.

This is not to say that there is not a concern about improving teaching through professionalization based on formal teaching qualifications. Learner diversity in contemporary TVET institutions is clearly a long way from the homogeneous relations of socialization into craft of days gone by, and teaching is recognized as crucial for enhancing learning for all students. The theoretical justification for this emanates from different versions of progressivist and constructivist learning theory, prompted by a 'practice to theory' rationale (Bird, 2010; Mjelde, 1997; and, as described by Egan, 2002).

The problem is that there is simply no easy fit between formal systematic, scientific knowledge and practical activity. Teachers would dearly like it to be so, since it would make the job of teaching principled knowledge much easier, and mathematics and science would not pose the challenges that they do – for all students, not only for those who enter formal learning with an educational disadvantage. Unfortunately, as Layton argues, 'the "problems" which people construct from their experiences do not map neatly onto existing scientific disciplines and pedagogical organisation of knowledge'(1993, p. 11). For Pye it is the 'prepared mind' that is able to 'abstract a class of result from particular objects and to see the analogies between results' (1978, 60). A decentring of the teacher may provide us with a semblance of democratic, learner-centred, experientially driven, outcomes-based pedagogy, but it evades the knowledge question. Without access to knowledge in all types of TVET curricula, the ideal of a learning progression continuum that leads to career advancement and mobility will remain elusive.

When the knowledge question is taken seriously we would do well to consider Shulman's (1986) theorization of the knowledge base of teaching. Taking content knowledge in teaching as one domain,[3] Shulman describes it in terms of the categories of subject matter content knowledge, pedagogical content knowledge and curricular knowledge, thereby positioning subject matter knowledge as the central axle around which all other forms of teacher knowledge revolve. Pedagogic content knowledge refers to ways of formulating and representing the subject to make it comprehensible to others. A further distinction is made between lateral curricular knowledge, which involves being familiar with the curriculum materials being studied by students in other subjects they are studying at the same time, and vertical curricular knowledge, which refers to familiarity with the curricular materials taught in the same subject in preceding and later years in school (Shulman, 1986, 10).

When TVET teachers understand their subjects or fields of expertise in general procedural terms, they teach procedurally. When they understand their subject or field of expertise as based on its disciplinary antecedents, its applied knowledge base and its repertoire of skills and dispositions, they teach in the manner attributed to the established professions, as discussed by Schein earlier. Paradoxically, when they do so, their practice most likely resembles that of the old 'master-artisans as pedagogues'. The crucial difference is that their teaching expertise is no longer based on tacit or uncodified versions of practice, but on a codified, scientifically grounded knowledge base that informs practice.

There is enough evidence in different fields of educational practice for us to understand that learning does not happen in the absence of teacher expertise in what to teach and how to teach it (e.g. Hodson, 1992; Layton, 1984; Morais and Neves, 2001; Muller and Gamble, 2010; Schmittau, 2005). Strong formal teaching

[3] Other domains mentioned are individual differences among students, generic methods of classroom organization and management, history and philosophy of education, and finance and administration (Shulman, 1986, p. 10).

and learning, aided by various educational technologies and premised on an up-to-date understanding of the vocational, technical and professional field of practice is what is 'good enough' for TVET. Nothing less will do to ensure that we fill in the 'hazy spaces' between equitable access and excellent innovation to achieve a continuum of learning progression that serves all young people and not just the 'privileged' few.

7 Conclusion

The argument put forward in this paper has been that a deepened understanding of knowledge differentiation in curricula necessitates a reconsideration of the competence base of TVET teaching, and by implication, of its capacity to bring about successful learning and further learning progression. TVET teachers need to have subject knowledge, and they need to know how to teach that subject and how to construct a curriculum. This has to be the 'core' of TVET and not the 'periphery'. But in order to replace educational knowledge as 'generic' with a stronger understanding of the relation between a particular form of knowledge and its pedagogy, we need to move away from the broad-brush ways in which we often use the terms 'knowledge' and 'practice' so that we grasp the constitutive effect that different forms of knowledge have on what counts as practice. Only then will we be able to conceptualize education in general and TVET in particular in ways that avoid 'low quality education as poverty trap' (Van der Berg, 2011) as the endpoint destination of many young people in different countries. And only then will we meet the knowledge demands of innovation and higher-order excellence.

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