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CONTENTS

FOREWORD

Rekindling Technical and Vocational Education and Training (TVET) in the Caribbean

Technical and Vocational Education in the Caribbean has over the decades been an area of contest and controversy in the curriculum. As elsewhere in the world, it had often been viewed as second-class education, suited more to other people's children. But the subject persists despite its uneven history, and a measure of its tenacity is that its content is examined and certified by the Caribbean Examinations Council (CXC). For decades, the received view about TVET as a subject to be offered in the formal school system of developing countries has been that such practice is ill-advised, for a host of reasons including its expense, the lack of properly certified teachers, and the mismatch between the content taught and the destinations where students find themselves on graduating. The counsel has been that it is better to postpone such education and to situate it closer to employment, in structures such as apprenticeship. This view is seen particularly in the opinion of World Bank experts, a very prominent work of this order being Psacharopoulos (1991), in which the author offered a quite condescending reading of TVET efforts in the developing world.

But across the globe in the 21st century we can see efforts to connect school curricula with the workplace. This resurgence has come amid a movement to conceive of the subject less in terms of the development of craft skill and more in terms of a more broadly conceived set of competences that combine academic and vocational content. This resurgence often draws upon the work of John Dewey, who, in his work *Democracy and Education*, advocated a more broadly educational approach to the subject with a focus on connections among work, family, and community. A good example of the rethinking about vocational education are the competencies set forth in the SCANS (Secretary's Commission for Achieving Necessary Skills) report on what the subject should look like in American schools.

One strong global trend is a focus on work-based curricula, an approach that offers multiple prospects for approaching TVET. Included here are internships, job-shadowing, apprenticeships, and service learning. This focus is part of an attempt to make learning at school more active and authentic than is customary. The European Union provides a prototypic example of the global focus on this approach to education, seen in programmes such as "Leonardo da Vinci." German apprenticeship continues to be a global model for linking schools and workplaces.

Here in the Caribbean we have accepted the global focus on the establishment of Qualification Frameworks and National Vocational Qualifications (NVQs). Secondary school students across the region can gain access to Caribbean Vocational Qualifications (CVQs) in various TVET disciplines at the end of Form 5. CVQs provide a graduated system of skills that would facilitate not just a stable set of standards within countries, but also parity of standards as workers move from one country to the next. National Training Agencies in the region, under the banner of CANTA (Caribbean Association of National Training Agencies) are busy seeking to get their skill standards systems on stream.

This special issue of *Caribbean Curriculum* focuses exclusively on Technical and Vocational Education and Training. The issue is timely in that it was developed in parallel with the start-up of an MA degree in Vocational Leadership at the School of Education at the St. Augustine Campus of The University of the West Indies (UWI), which is coordinated by Cipriani Davis. The issue reflects Caribbean Technical and Vocational Education (TVET) on the move.

In the first paper by Halden Morris and Carole Powell, the authors report on a pilot project in Jamaica in which a practical approach to TVET implementation was attempted. The programme featured the sharing of upgraded resources in two Parishes in Jamaica. It featured collaboration between a wide-ranging set of stakeholders, including parents, students, and industry representatives.

In the second article, authors Sharmila Harry and Tricia Smith report on an ethnographic study of talk in a TVET classroom in Trinidad. They took the approach that talk in the local classroom might be conducted on the basis of the respective power positions of teacher and student. The teacher would be dominant, the students would acquiesce meekly. Their finding was that whole-class discussion dominated the dialogue, and offered several reasons why this might be.

In the third article, Raymond Dixon examines trends and issues in technology education in the USA, with implications for the Caribbean. The paper identifies critical funded projects that helped transform the field to the point where it now heavily reflects an engineering focus. Highlighted in the review is the "Standards for Technological Literacy"

(STL) project, which helped transform school curricula globally, and the National Center for Engineering and Technology Education (NCETE), which brought engineering in schools into focus and yielded a number of new PhD s who have now taken up the mantle of STEM leadership in the United States.

The fourth article, by David Subran, asserts that TVET in Caribbean schools must make adjustments to accommodate new postmodern realities. Postmodern societies are complex, being characterized by uncertainty and rapid change, Subran contends, and they require greater acceptance of diversity and willingness to be more inclusive. TVET cannot proceed with business as usual in the face of these changes. There must be greater infusion of academics into vocational content.

Stafford Griffith reports on his comparison of the performance of CSEC and CAPE technical and vocational students with students pursuing more traditional subjects. The aim was to determine the extent to which there was parity in the numbers of students from the two tracks who had progressed to the end of fifth form, and to see if one group was academically superior to the other. The results provide good data on vocational course-taking in Caribbean schools, but do not support the popular view that it is the less able students who pursue technical and vocational subjects.

In the sixth article, Halden Morris explores ways of thinking about quality assurance for TVET programmes. Information for implementing quality assurance regimes is provided.

In the final article Theodore Lewis points to tensions surrounding the measurement of competence and skill, and suggests that these must factor into our thinking as skill standards are set across the Caribbean. The main challenge here is that in many instances it is quite difficult to atomize skilled performance. This will especially be the case where tacit skills are involved—or where skill is embodied in the performer. The article points out that beyond the question of meeting standards is the need to recognize that experts rely on attributes (such as intuition or judgement) that are not easily reachable by novices. There is also the question of ethical standards in skill, which distinguish between performers who function at the level of *techné* and those who do at the level of *phronesis*, where practice is morally imbued.

Taken together, the articles in this special issue all point to the prospects and possibilities for the rejuvenation of TVET in the region. There is work to be done to be sure, including reform of TVET policy, and a more focussed approach to research. But opportunities abound for those who are drawn to the field.

This special issue had the strong backing of Professor June George, and the then Head of Department at the School of Education, Dr. Susan Herbert. It was brought to fruition by the tireless work and technical insights of Editor Lynda Quamina-Aiyejina. Recognition is due also to the group of reviewers, from the Caribbean and elsewhere, who responded to our call.

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DELIVERING TVET AT THE SECONDARY LEVEL: A Practical Approach

Halden A. Morris and *Carole M. Powell*

Secondary education can be regarded as the watershed of the education continuum, as it is positioned between compulsory primary education and the world of higher education, training, and work. Hence, curricular content at this level should be enriched and should be culturally sensitive towards the holistic and relevant development of learners. The scope to provide a complementary mix between academics and technical and vocational education and training (TVET) in order to respond to global demands is evident, and should be pursued in order to facilitate human capital development (HCD). Challenges envisioned and experienced in implementing such formidable curricula exist, nevertheless with smart engaging approaches it is believed that these can be overcome. This paper presents a practical approach piloted in Jamaica to facilitate the delivery of TVET in an economical manner. The approach emphasized gains in sharing upgraded resources for the delivery of TVET.

Introduction and Background

As the sequel to compulsory primary education, secondary education presents a major watershed in the education continuum. This is particularly so as it prepares the way for entry into higher education and training, the world of work, or both. Secondary education is therefore a crucial arc in the learning curve and should offer an enriched culturally sensitive curriculum for the holistic development of learners. Goldin (2001) has noted that prior to the turn of the 19th century, industrial nations like the US and UK keenly eyed technology and physical capacity as the only sources of economic greatness. However, by the early 20th century, new insights revealed the power of human capital in the enhancement of economic production. Thus, according to Goldin, human capital development (HCD) became important as a modern concept in support of realizing the wealth of nations. Goldin further pointed out that it was the US which led the way in post-elementary or secondary education of the masses in support of HCD, which involves the educating and training of people. To fulfil the new mandate as identified and accepted by the US and other industrial nations, the curriculum for secondary education became a feature for serious consideration and much debate.

Ravitch (2000) has written that within the US, until the mid-19th century, most of the secondary schools not only offered the classical curriculum of Latin, Greek, and mathematics, but also what was known as "modern subjects" such as history, science, English, and practical subjects such as bookkeeping, surveying, and navigation. At that time, the crux of the debate among education leaders revolved around whether or not curricular provision should educate students for college or for work. Ravitch pointed to teachings of the 19th century English philosopher Herbert Spencer, who was himself a contender in the debate. Spencer posed the signal question as to which knowledge was of most worth. His conclusion was that knowledge which prepares an individual for complete living was to be deemed most valuable. Knowledge for complete living took into account the multifaceted nature of human existence, and hence our need to know, to understand, and to do, so that we would be enabled to subsist, at the very least. This conclusion was one among similar opinions from powerful countries like France, Germany, and Sweden that heralded the addition of manual and vocational training to the secondary education curriculum and placed it on a firm footing. This novel and potent curricular inclusion spread in due course to the rest of the world, including the Caribbean.

A historical review of the Caribbean identifies the genesis of vocational education as far back as the mid-19th century. The early days of colonization saw the establishment of an apprenticeship programme where individuals were taught a craft or trade by someone already engaged in it. Payment for the instruction was in the form of a stipulated number of years of work which was given back to the said establishment or concern. By 1896, the early formalization of vocational education was effected by the establishment of Kingston Technical School in Jamaica. This and other such developments in the region was in response to the new era of self-government and its attendant need for commercial and manual skills to service local enterprise. More recently, in the formulation of its *Draft Plan for Educational Development in Trinidad and Tobago, 1968-1983*, the Government of Trinidad and Tobago stipulated that "the curricula and syllabus used in the educational system at all levels should be brought in line with modern trends and the needs of the country as a whole" (Alleyne, 1995, p. 86). During the implementation period of the plan, the Prime Minister, Hon. Dr. Eric Williams, proposed some guidelines, which were approved by Cabinet and resulted in what was deemed a signal guide for secondary curriculum planning in Trinidad and Tobago. One proposal was "that an integrated comprehensive program embracing the traditional academic, pre-technical, commercial, general industrial and limited specialized craft training be adopted as the national model for the 14plus education" (Alleyne, 1995, p. 87).

Thus, in the Caribbean, the formalizing of manual and vocational training, as evidenced by the establishment of technical schools and the inclusion of practical subjects in schools' curricula, occasioned a complementary partnership between practical and academic subjects. This partnership, experienced worldwide, evolved into the formidable construct referred to as Technical Vocational Education and Training (TVET).

TVET is said to present that side of curriculum that activates the notion of applications learning, whereby the learner is made to consider the relevance of all knowledge gained. By way of the discipline, therefore, the learner becomes poised for meaningful entry into, and existence in, adult life and living. UNESCO (2011) has provided the following definition of TVET:

> A comprehensive term referring to those aspects of the educational process involving, in addition to general education:
>
> - the study of technologies and related sciences;
> - as well as the acquisition of practical skills, attitudes, understanding, knowledge relating to occupations in various sectors of economic and social life. (slide 4)

UNESCO further stipulated that TVET should be understood as:

- an integral part of general education;
- a means of preparing for occupational fields and for effective participation in the world of work;
- an aspect of lifelong learning and a preparation for responsible citizenship;
- an instrument for promoting environmentally sound sustainable development (Greening TVET International Framework)
- a method of facilitating poverty alleviation. (slide 4)

For Jamaica's Minister of Education, Hon. Burchell Whiteman, the emphasis was on the ability of TVET to provide the individual with competencies (knowledge, skills, and attitudes) required for on-the-job and tertiary advancement in pursuit of technological careers. He concluded that "TVET is not therefore 'reclamation' education for those who fail to achieve academic excellence" (1992, p. 2). The following CARICOM predecessor statement, which was based on a survey done in

1990, saw TVET covering all programmes and schemes that contribute towards the development of knowledge and skills required for work: "It transcends education systems provided by Ministries of Education, and includes many additional non-formal programmes provided by other government Ministries and Departments, by private colleges and by informal in-plant and on-the-job training" (CARICOM, 1990, p. 48).

Based on all that TVET means to these academics and practitioners internationally and regionally, it is clear that the discipline is an all-embracing process employed to prepare the human resource stock in society to enrich the labour force, with the aim of achieving competitive advantage in the global environment.

Morris (1998) offered the following recommendations for further development of TVET at the secondary level:

1. More funds should be allotted to the development of the technical and vocational section of secondary schools. Providing state-of-the-art equipment should be emphasized.
2. The government should provide more secondary places by building more secondary schools in addition to upgrading existing schools. Currently 50 additional schools with a capacity of at least 1,200 students each are needed.
3. Secondary schools across the island should be selected for phased development to deliver more advanced secondary education to a wider cross-section of the population.
4. Technical and vocational education at the secondary level should be promoted nationally. Large widescale advertisements might appeal to youngsters who would not otherwise have selected this field.
5. Bright students should be encouraged to study technical and vocational subjects to the tertiary level.
6. Students should be encouraged to establish junior technical and vocational training organizations. These would facilitate leadership development and social interaction.
7. Technical and vocational teachers should be encouraged and given incentives to join professional organizations in their field.

8. Technical and vocational teachers should be required to work in industries periodically to ensure knowledge of current industrial procedures. (pp. 125-126)

The question is, to what extent have these recommendations been considered in the development of TVET at this level? In considering an answer to Morris's question, it must be noted that to institute viable TVET systems there admittedly are some serious challenges; nevertheless, with smart, engaging approaches these challenges can be overcome.

Financial Challenges

TVET by its very nature, definition, and content has been seen as a difficult option to accommodate within the Caribbean formal school system for many reasons. Primarily, the experiences of participating nations have identified funding as the greatest challenge.

Henderson Eastmond, Executive Director of the TVET Council in Barbados, stated that:

> One of the challenges facing Technical and Vocational Education Training (TVET) is the high cost and sustainability of its programming…One of the challenges being faced in the Caribbean is how to increase the involvement of the private sector in the funding of TVET. (High cost of TVET, 2011)

In addition, Eastmond alludes to the maintenance of equipment, the upgrading of facilities, and the professional development of staff as major cost factors. Hutton (2012) reviewed the CARICOM Regional Strategy for TVET, and among the areas of least accomplishment, he highlighted inadequate or obsolete infrastructure and inadequate funding mechanisms for implementing TVET. These and other such observations lead to the conclusion that, for TVET in the Caribbean, lack of financing has been the central factor curtailing its development. It is heartening to note, however, that in the face of these challenges there are valuable lessons emanating from both the international and regional scenes with respect to responding to the challenges of financing TVET. The search continues for key elements to establish and bolster informed TVET systems in an affordable manner.

The Jamaican Ministry of Education began seeking to create and strengthen partnerships with other related public bodies and Ministries within the country, and to engage full participation of the local private sector to ensure the strengthening of the TVET system. This was substantiated by the input for TVET in the 5-year Plan for 1990-1995, thus committing to the concept of HCD as the primary tool for the achievement of social and economic development. For these reasons, the Planning Institute of Jamaica (PIOJ) (1991) noted that, in conjunction with the Ministry of Education, the Government's policy perspective was to develop a quality TVET system in support of the notion that investment in human capital would produce greater returns in the long run than investment in material resources. There are examples from Europe and Asia and from within the Caribbean which seem to declare that policies of inclusion for TVET, which encourage shared responsibility, show the way forward.

A Pilot Response Towards a Model for Affordable Secondary Level TVET Delivery

TVET practitioners like Hutton (2012), Morris (2011), and Eastmond (High cost of TVET, 2011) are in agreement that the lack of sustainable development of Caribbean TVET systems is due to the paucity of input resources as a result of inadequate funding. Jamaica's response was affected by this factor, and has been dogged by the problem of an overwhelming outflow of unskilled and uncertified graduates from the secondary school system annually. The country thus committed itself to explore avenues that might address the challenge within its boundaries, in the most cost-effective manner. The Ministry of Education marshalled the support of its National Training Agency (NTA) in its quest for enhanced HCD, by engaging its secondary schools as a premier resource. The integration of TVET into curricula was seen as the strategy to be employed in this regard; hence a pilot project was undertaken to identify the most cost-effective way to realize the favoured outcome. The pilot plan was implemented in stages, so that findings would be timely, measurable, and useful.

In view of the problem, the Ministry of Education pondered whether or not the secondary school could be regarded as a part of the engine for economic growth and national development in Jamaica; and, if so, whether it could play a role in the nation's HRD by promoting equitable access to relevant quality TVET. The joint pilot project on rationalizing TVET in secondary schools set out to provide some answers in this regard.

The Pilot Project

The pilot project, entitled *TVET Rationalization in Secondary Schools,* was initiated in 1998. The project title referred to: "the integration of

TVET in secondary schools' curricula, emphasizing the ensuring of access and equity; the assurance of quality and relevance; while creating greater efficiencies in a comprehensive education framework" (Jamaica. Ministry of Education [MOE], 2010). The basic format employed by pilot implementers was to upgrade all input resources and then share them. Input resources for TVET, such as plant, equipment and tools, furnishing, curricular programmes, programme materials, administration, instruction, and career guidance were thus upgraded and then shared among schools within the pilot domain.

The Process

Launch and leadership. The Ministry of Education, in conjunction with the NTA, engaged the services of two consultants from a local human resources and organization development firm in late 1997, and launched the project in the domain identified. The domain covered two parishes—St. Elizabeth and Westmoreland—which are parishes situated in the south-western and western end of Jamaica, respectively. By January 1998 a project director was engaged to represent the Ministry, and the project team was established, consisting of the two consultants and the project director. The team reported to a management committee co-chaired by the Chief Education Officer and the Executive Director of the NTA. Other members of the committee were the Assistant Chief Education Officer in charge of the Technical and Vocational Education Unit (Tech/Voc Unit) of the Ministry; the Deputy Chief Education Officer; and the Chief Technical Director of the NTA.

Early activities. Beginning with intensive consultation with primary stakeholders, the first segment concentrated on creating awareness of the Ministry's concerns and quest, as well as on fact-finding. Primary stakeholders were principals, teachers/instructors, teachers' union representatives, parents, board chairmen, community employers, and, most importantly, students. Consultations were effected by way of (a) organized team visits and revisits to all 17 secondary schools within both parishes; (b) community tours executed by a demographic specialist; and (c) specially organized team meetings with board chairmen and Parent Teacher Association (PTA) representatives of all 17 schools. Special meetings with officers of regional directorates of the Ministry of Education also added to the rich backdrop provided, and helped to inform further planning and the pilot process. The TVET rationalization plan and principles were the primary output from the wave of early consultations, data collection, team meetings, and management meetings. It was said that the participatory approach yielded "valuable information and considerable goodwill" (Tomlinson, Powell, & Neil, 2005, p. 4).

The TVET rationalization plan and principles. In deriving the plan, foremost in the minds of team members was the Ministry's mandate to ensure access, equity, relevance, and quality in the most cost-effective manner. This mandate informed the following far-reaching recommendations:

1. Sharing of scarce resources
2. Formation of school clusters geographically
3. Derivation of an optimal mix of TVET programmes
4. Physical upgrading of existing school plants to accommodate 68 work labs or centres of excellence
5. Installation of modern equipment, tools, and furnishing
6. Instituting strong career guidance programmes
7. Upgrading/sensitization of school and Ministry staff, and the community in general.

Based on the recognition of a dearth of funds in the system, the notion of sharing resources proved to be the linchpin of the TVET rationalization endeavour. Sharing resources was facilitated by an operating model based on the cluster concept, whereby all schools in the pilot domain were grouped into five geographic clusters of three or four, and the resources allocated were shared intra-cluster.

***Optimal mix of TVET programmes*.** An array of TVET programmes was identified by stakeholders and advised by the National Council on TVET (NCTVET) as being relevant to the communities' and the country's needs. The array included:

1. Agriculture
2. Auto Mechanics (Secretarial)
3. Building Technology
4. Business Education
5. Clothing & Textiles
6. Cosmetology
7. Electrical & Electronics

8. Food & Nutrition
9. Home Management
10. Information Technology
11. Machine Shop and Welding
12. Plumbing & Pipe Fitting
13. Visual Arts

These programmes were deemed practicable for delivery in schools and were to be offered in every cluster to ensure equity. The list of programmes could not be exhaustive for reasons of practicability and funding, but it provided the best possible base for introducing work-based education in a variety of TVET skills, and was therefore termed the “optimal mix.” Within each cluster, schools were assigned to host specific programmes based on the concept of “lower hanging fruit.” The concept led to the ascertainment of projected least financial cost and effort for programme development in different schools, based on already existing plant and equipment. For example, some schools were already hosting comparatively successful programmes because of infrastructure and set-up; these labs were seen as lower hanging fruits and were upgraded to suit the new requirements and to accommodate the expanded numbers. If a programme was not earmarked for upgrading and was present in a school, it was phased out. However, fairly early during the introductory phase of the pilot, three of the programmes in the optimal mix, Information Technology, Food & Nutrition, and Home Management, were deemed to be of such urgent value to all schools that they were mandated as imperatives. As a result, these were not phased out of any school. Instead, all schools were encouraged to ensure their sustainable development on each and every plant.

Staff development. The staff development exercises were in-service and covered the upgrading of instructors/teachers, guidance counsellors, work-experience coordinators, principals and vice principals, education officers, and directors of the Ministry of Education and the NTA. The Tech/Voc Unit was relied on to recommend and follow through with the upgrading of existing TVET instructors/teacher, in the skills and in pedagogy. Professional Guidance Information Services (PROGIS), now Career Development Services (CDS), of the NTA guided the upgrading process in the area of Career Development and Counselling. This body prepared guidance counsellors and work experience coordinators in career awareness, planning, and the development of career programmes for their respective schools. The plan also indicated the need to have targeted upgrading and awareness sessions aimed at principals and other school administrators, education officers, and directors and managers of both the Ministry of Education and the NTA. The core content of upgrading sessions for this group included:

1. Change management
2. SWOT analyses
3. Creating synergies
4. Force field analyses

Study tours to a rationalized TVET system in Oklahoma, USA served to enrich the awareness process and ratify the pilot endeavour.

The integration. The integration of TVET into the curriculum of pilot schools was approached by way of process facilitation. The main elements in this regard were:

1. TVET rationalization plan and principles
2. Human and physical resources
3. Curriculum based on internal programmes and external examinations
4. Intra-cluster timetables
5. Shuttle schedules

The integration relied heavily on the phasing of activities to give latitude for timely injections from the funding sources, as well as to facilitate replications in an iterative mode. Except for initializing events and activities, replication of all events and activities was guided, and thus tempered, by lessons learned by all relevant stakeholders from predecessor phases, during the iterative process. Quality was ascertained by way of the physical upgrade of work labs and the acquisition of state-of-the-art equipment and tools; it was also facilitated by the upgrading of relevant staff. Access to the quality resources was facilitated by the input of a dedicated shuttle system, which was guided by integrated cluster timetables and shuttle schedules. The cluster concept facilitated sharing of quality resources equitably, and relevance was ensured by the industry-informed optimal mix of TVET programmes. A crucial aspect of the integration was establishing complementarities between TVET and the academics. This was deemed an imperative for applications learning and, according to pilot implementers, was seen as the heart of the TVET integration process. Subject packaging around TVET programmes was pivotal to the establishment of complementarities during operationalization.

Implementation

Implementation of plan and principles, the second segment of the pilot, was effected in three phases, mainly because it was not possible to have items in place all at once throughout the domain.

Phases

1. Pilot-in-pilot

Starting September 1998, this initial phase of implementation was effected in two stages. The first stage saw two out of the five clusters (one in each parish) addressed and operationalized at one programme per school. The second stage saw the addressing and operationalization of the remaining three clusters at one programme per school.

2. Pilot roll-out

This phase addressed operationalization within all five clusters and was concerned with the development and operationalization of all remaining TVET programmes as reckoned by the optimal mix.

3. Replication I: Corporate Area

This phase was introduced based on a strong recommendation from officialdom to intensify public awareness of the TVET rationalization concept throughout the wider Jamaican community. In addition, it served to create an opportunity for the examination of any differences in accommodation and management of the concept in urban Jamaica.

Challenges

Implementers claim that challenges presented themselves as the pilot process flowed. Chief among the challenges emerged as a result of gaps in the support system rather than with the operating mode per se. According to Powell (2013), all concerned in the implementation referred especially to:

a. **The lengthy time it took for on-the-ground action to start and to be completed**. This gap was created mainly due to bureaucratic delays**.** These were encountered especially because there was a lengthy chain of action in the upgrading of physical plant, as well as in the procurement of tools, equipment, and furnishing. The chain of action for any one of these activities lasted many months, even up to two years in the case of physical upgrading works.

Human frailties also contributed to time lags. This was seen in the attitudes of some primary stakeholders on the ground, who only budged after several bouts of moral suasion by project team.

b. **The sometimes awkward decision making in allowing students access.** There was sometimes a difficulty for school staff in acquiescing to students' choices of programmes, reasoned hosting of programmes per school, and timetable integrating exercises.

Dedicated transportation also affected student access. In this regard, the greatest setback was experienced during down times of designated buses, "there being no affordable provision for redundancy in the system" (p. 288).

c. Barriers to effective instruction. These were experienced due largely to the unavailability of knowledgeable instructors. In cases where the instructor resigned, it often took in excess of a year to receive an adequate replacement. In cases where the instructor took leave, there was usually no replacement. In both cases, lab assistants were relied upon to keep the students occupied.

Inadequate monitoring, due to a deficiency in the number of technical officers in the Ministry, also affected instruction. This was a sore point, as many instructors required guidance in curriculum choice, management, and methodology.

Successes

In spite of the challenges, however, records show that successful outcomes were seen in terms of physical plant and equipment upgrade, student enrolment and performances, staff development, and policy development.

Throughout the period 2001-2007, as shown in Table 1, access was increasingly extended to more students from all 17 schools (five clusters) in the domain, with the rate of student increase averaging 17.7%. The annual increase in access, though modest, was encouraged by the upgrading of more TVET work labs annually and the inclusion of more TVET programmes. By 2007, over 3,000 students had gained access to an optimal mix of 10 TVET programmes offered from 51 upgraded and highly equipped work laboratories. The figures also show that in respect of external examinations—Caribbean Secondary Education Certificate

(CSEC) Technical Proficiency and National Vocational Qualifications (NVQs)—the entry numbers increased by 52% over the period under scrutiny. Though students' performance showed an inverse relationship between number of entries and percentage passes, the passes never fell below 60%.

Table 1. Comparative Exam Data for TVET: 2001-2007

Year	Entries	Passes	%
2001	609	453	74.4
2002	895	551	61.6
2004	585	364	62.2
2005	537	406	75.6
2006	661	519	78.5
2007	926	552	59.6

Each programme of the optimal mix was externally examined, and implementers claimed that some landmark successes had been masked by the modest figures. They referred to three of these successes specifically. Two materialized when, in 2006, two students from the domain but from different home-schools commuted to schools within respective clusters in order to access TVET studies in Agriculture and Business Education. They were not only successful in the NVQ external examinations, but topped the regional cohort for that year. The third referred to a group of Grade 10 students who likewise commuted, and after the first year of the two-year TVET programme in Auto Mechanics sat the NVQ-J and successfully received certification at Level 1. Another point emphasized was that, based on a limited Tracer Study done in 2003, implementers were able to conclude that directly out of pilot domain schools, at least 17% of leavers got employment in positions for which they were certified.

Much of the successes claimed were due to elements of staff development occasioned during implementation of the pilot plan. By way of in-service training, which included retreats, seminars, meetings, workshops, and study tours to a rationalized secondary school system for

TVET in Oklahoma, USA, school staff were schooled in higher-order TVET instruction methods, and sensitized to the benefits of establishing the desired complementarities en route to a transformed education system. It was always hoped that output from the transformed system would support the national thrust at HCD, towards economic development**.**

Piloting the rationalization of TVET in secondary schools led to the development of a policy for TVET in Jamaica. With a mandate for TVET integration in schools' curricula, pilot project staff initiated policy development sessions throughout the domain. These sessions were addressed by co-chairs of the management committee and involved the contribution of principals and vice principals of the pilot schools. As the processes flowed, it became obvious to the Ministry that the lack of TVET policy stymied progress in this regard. Hence pilot staff were directed to formalize their work on policy development and prepare the first concept paper on a policy for TVET in schools. This was later refined and embedded into the policy for compulsory education. The policy statement read:

> The Government of Jamaica through the Ministry of Education must make provision for all students at the upper secondary level to pursue at least one TVET offering leading to approved work-based certification nationally, and globally. (p 15)

Post-Pilot Status of TVET in the Domain

The status of TVET in the domain was analysed and measured during the immediate post-pilot period by way of Portfolio Analysis, as popularized by Heitmann (1996). Firstly, the pilot domain was scrutinized to ascertain whether or not it could be likened to a subsystem for TVET, by identifying with Heitmann's nine characterizing elements:

1. Learning sites
2. Fields of study or training
3. Shares of "general" and "vocational" elements within curricula
4. Degree of modularization within curricula
5. Level of education
6. Duration of study or training
7. Entry requirements
8. Certificates or qualifications obtained

9. Entitlement/access to further education or training

These elements were all addressed in the pilot, thus the pilot domain, inclusive of rural and urban sections, was viewed as a TVET subsystem to be scrutinized, operating under the category Technical Education. The analysis then proceeded and indicated contributory factors affecting the subsystem's internal efficiency, which was measured by its condition; and the subsystem's external productivity, which was measured by labour market orientation.

Indicators examined for internal efficiency were: architecture, administration and organization, quality and condition of TVET in physical and material resources, training of teachers and instructors, and costs of operation. On the other hand, those examined for external productivity were: government TVET policy and its objectives, qualification needs and manpower distribution, attitude of firms and organizations towards TVET, and employment of graduates and school leavers in posts that correspond to their training.

Subsequent to a series of examinations, weighting and scoring of all indicators and their elements, the overall rating of internal efficiency, based on the final score of 86%, was "High"; and that of external productivity, based on a final score of 39%, was "Low" (Powell, 2013). The outcome pointed to the areas for development and hence should advise policy and indicate areas for financing without redundant expenditure. According to Powell, the motive behind executing the portfolio analysis was to discover areas that needed to be addressed, invested in, and developed towards the sound economic infrastructure that TVET can promote.

Main Post-Pilot Activities

1. ***Mainstreaming plan.*** The plan, titled *Roadmap for Mainstreaming TVET in Jamaican Public High Schools*, was commissioned by the NTA and executed by the pilot team, headed by the FACTS Limited consultants. It was not only informed by documented pilot experiences, but also by a series of consultations with key organizations. The organizations targeted were The University of the West Indies (UWI) and the University of Technology (UTech); the Ministry of Labour; head of the labour unions' alliance; teachers' union representatives; representatives from the high school principals' association; representatives from the Private Sector Organization of Jamaica; tourism sector representatives; and representatives of the Jamaica Employers' Federation.

The first activity to mark implementation of the plan was a virtual clustering of secondary schools island-wide. The outgoing pilot staff, along with staff from the Ministry and the NTA, travelled the entire island, in order to execute this aspect of the plan

2. ***The Career Advancement Programme (CAP)*.** This was, in effect, an elaboration of the TVET rationalization in schools programme. It involved the introduction of an additional two years to the school life of students in general—the senior school. Here, senior students (post-Grade 11) were to continue general academics and pursue TVET at Levels 2/3 according to the learner's level of attainment.

Conclusion

Regional and international trends, projects, and experiences point to the eminence of TVET. This seems to be so because the discipline, by its very nature and potential for output in terms of HCD, supports a path towards the economic development of nations. Its integration into formal secondary education is therefore prudent, as this is the route through which the human resource stock of contemporary society must travel, before arriving at the productive platform. In order to satisfy the demands for quality resource inputs for TVET, the reality of increased financial injection into formal education systems must be faced. Countries in the region must thus pay keen attention to the strategies employed by international partners like Australia, Europe, and Eastern Asia, and to the approach taken by Jamaica, as described above. They must pay particular attention to policies of inclusion and resource sharing, as these are formidable trends towards affordability. Lessons learned from these sources should be reflected upon and put into practice where feasible.

One critical factor that has been known to present hindrances to expeditious TVET delivery is popular attitudes towards the discipline. For example, in the case of Uganda, Ghobadi (2010) explained that there were still people who believed that the aim of TVET was to provide an outlet for school dropouts. The UNESCO (1983) position was that the situation of inadequate preparation of school-leavers seemed to, among other things, be exacerbated by a perception that TVET is a substandard alternative rather than a complement to the academics in general education. According to UNESCO, that perception of TVET led to, among other things, the delivery of TVET programmes from ill-equipped workshops, and a persistent scarcity of qualified persons to teach in the field. The Jamaican pilot implementers reported that piloting the TVET rationalization in schools intervention was a huge challenge, mainly because of attitudes towards TVET. One of the implementers explained this challenge and the effects thus, especially with reference to the experience in Corporate Area Jamaica:

> *This low perception operates at all levels of the society. We have seen traditional high schools resisting the advent of these programmes in their schools … even some Principals would not accept the concept in Kingston so they opted out, and some Boards opted out of participation which was very heart-breaking for us…* (Int. 1. L 19-23, p. 4). (Powell, 2013)

Much was therefore dependent on the willingness of players to accommodate the changes and adjustments necessary for implementation. Thus, much more time than initially anticipated was spent exercising moral suasion. This was not only necessary in respect of school staff and community, but also in respect of Ministry staff from whom much of the mobilizing support was expected. These and other experiences have prompted the advice that it is urgent for nations to devise public education strategies to facilitate the development of policies that will, in the interest of time, expeditiously counter the lingering public bias against TVET. This is to be borne in mind as we reflect on the old adage: *Time is money.*

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WHAT DE TEACHER SAY?
Talk as a Mode of Inquiry in Curriculum Enactment in a Technical-Vocational Classroom

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This article examines the modes of triadic dialogue that emerged between a technical-vocational teacher and a group of 14 fifth form students at a senior comprehensive school in Trinidad. It also explores the teacher's perspectives of the factors that influenced his talk during the practical sessions. Data collection techniques involved the use of classroom observations, as well as semi-structured follow-up interviews. Data analysis included discourse and conversation analysis, as well as the coding of data into themes and categories. The findings reveal that whole-class discussions dominated the hands-on practical sessions. In addition, greater monologic applications of the Initiation-Response-Evaluation (IRE) mode of triadic dialogue took precedence over Initiation-Response-Feedback/Follow-up (IRF) dialogic discourse. However, there was only one instance where dialogic engagement emerged from the IRF mode. Furthermore, the findings revealed that the lack of resources, time constraints, poor physical conditions, ineffective teacher training and professional development, lack of teacher knowledge and skills, and the examination structure were the factors that influenced the teacher's classroom talk.

Introduction and Background

> *"Babooji," Pooran said to his father, "de teacher say we have to forget everyt'ing we learn at home, an' learn only what he say."*
>
> *"Teacher is a smartman, boy. Babooji teach you how to plant cane, Leela teach you how to dress, comb hair, teacher have'um different sometin' for you to learn. You listen good to teacher."* (Ismith Khan, 2000, p. 3)

The legacy of colonialism in the Anglophone Caribbean has rendered types of talk in the classroom as reflective of two opposing camps and positions of power. In one corner, there is the teacher whose role is to initiate, direct, and regulate talk in the classroom. The teacher is in a niche decision-making position to select content that is relevant and contributory to classroom discussions. In the other corner, there are the students whose habitual role is to exercise compliance, passivity, and acquiescence to the teacher's instructions. The introductory excerpt, taken from Khan's (2000) short story, "Pooran Pooran," illustrates that the teacher's talk takes centre stage in the classroom. Indeed, this traditional pattern of talk between teachers and their students is one that several West Indian writers have captured in their writings. Senior (1985), in "Colonial Girls School," and Brathwaite (1977), in "Lix," have both captured through their poetry the dominant role of the teacher in streamlining content for transmission to students. While Lamming (1953) in his novel, *In The Castle of My Skin*; Hodge (1970) in *Crick Crack, Monkey*; Kincaid (1985) in *Annie John*; Lakshmi Persaud (1990) in *Butterfly in The Wind*; and Clarke (2003) in *Growing Up Stupid Under The Union Jack* have vividly described the tension between "what de teacher say" and how the students are expected to respond, through numerous examples of talk between both parties within the classroom. Collectively, these writings are a mere fraction of the vast amount of West Indian literary depictions of classroom talk, specifically, triadic dialogue. The term *triadic dialogue* was coined by Lemke (1990) to describe the three stages or sequences of talk that usually occur between teachers and students during whole-class discussions. The three-step pattern commences when the teacher initiates the discourse with a question, followed by the nomination of a student to respond, then the response is evaluated by the teacher as either *correct* or *incorrect*; *right* or *wrong*; *yes* or *no;* or further feedback is provided to the student.

The major modes of triadic dialogue are the Initiation-Response-Evaluation (IRE) mode and the Initiation-Response-Feedback/Follow-up (IRF) mode, where the latter has several variations, such as IRFR, IRNF, and INR (Pinkevičienė, 2011). Although both modes entail three moves, the most notable distinction between them is embedded in the third sequence. The IRE mode is considered asymmetrical and a form of monologic discourse, where the teacher maintains control of the interaction with limited avenues for student talk (Haneda, 2005; Mehan, 1979; Mercer & Dawes, 2008). This mode is commonly referred to as the recitation script, as the teacher's questions are intended to elicit fixed and correct answers from the students rather than to help them advance their views. In other words, "teachers and students speak according to very fixed perceptions of their roles," where "conversation in this case is very one-sided, with the teacher asking all the questions and the students answering them" (Pinkevičienė, 2011, p. 98). Significantly, as teachers mainly dominate the discourse, their students are precluded from opportunities to creatively explore their own ideas or ask questions, as their voices are devalued and marginalized (Barnes, 1992).

Notably, there seems to be a lack of consensus in terms of the usefulness of the IRE mode. Thornbury (2005) contends that "this kind of teacher talk has a long tradition and serves a very useful pedagogical purpose" (p. 80). It has "a built-in repair structure in the teacher's last turn so that incorrect information can be replaced with the right answers" (Newman, Griffin, & Cole, 1989, p. 127). Moreover, its gatekeeping functions, in terms of moving along a lesson and selecting which students should speak, has not been overlooked. However, Lemke (1990) argues that "true dialogue occurs when teachers ask questions to which they do not presume to already know the 'correct answer'" (p. 55). The IRF mode (Sinclair & Coulthard, 1975) is considered symmetrical, as there is more open dialogue, exchange of ideas, and discussions between teachers and students. If the teacher in the third follow-up move encourages "justifications, connections or counter-arguments and allows students to self-select in making their contributions" (Nassaji & Wells, 2000, p. 33), then the discourse moves from being monologic to dialogic or conversation-based. In this mode of triadic dialogue the type of initiation question used by the teacher can also encourage rich discussions and ideas. However, Haneda (2005) argues that regardless of the type of initiation question used, it is "teacher uptake in the follow-up move [that] appears to make triadic dialogue more dialogic by giving more opportunities for students to contribute" (p. 328). This view is further reinforced by van Lier's (1996) emphasis that the third move in the IRF exchange can encourage students and teachers to "emancipatory forms of discourse" (p. 168). Teacher uptake in the follow-up move involves a plethora of techniques that engage students in "offering elaboration or comment, justification, explanation, clarification, asking for clarification, or exemplification" (Haneda, 2005, p. 316) and the challenging of their perspectives.

Triadic dialogue is an area of research that has not generated mass critical appeal within the educational domain in the Anglophone Caribbean. The majority of research studies conducted in Trinidad and Tobago on teacher-student verbal exchanges in the classroom have focused on students' language competence, particularly the ongoing chasm between students' usage of Standard English and Creole (e.g., James, 2003; Joseph, 2008; and Phillip-Peters, 2008). Moreover, the thrust of these research studies at the secondary level has shown fidelity to traditional subject areas such as English Language and Literature. Perhaps a possible reason for this is embedded within colonial prejudices, which promoted that educational advancement is attained through the mastery of traditional subjects and, as a result, what constitutes *real* research has for the most part continued along those lines. Significantly, Campbell's (1997) research on technical-vocational education and training (TVET) provides other reasons for the overshadowing of technical-vocational subjects by traditional academic subjects. Though lengthy, his explanation is insightful:

> The education system and teachers had long been accustomed to the teaching of subjects like physics, history, or literature in formal educational institutions; and over many years local and foreign examinations of academic subjects had distilled and refined understanding of the level of knowledge appropriate to these subjects at various stages of students' life. The same could not be said about technical/vocational subjects for example, welding, dressmaking, carpentry or refrigeration. In the Third World wherever technical/vocational education was tried, it is not unusual to find a considerable amount of disorder and confusion in the curriculum. This arose from the very novelty and unfamiliarity of teaching these subjects in the classroom, but also it must be admitted that since specialized technical/vocational education was geared to the work place there was a greater need to define aims more clearly than in the case of academic subjects. (p. 158)

Campbell's (1997) research highlighted the fact that the advantage traditional academic subjects has over vocational subjects is embedded in their being "tried and tested" for years, which legitimized them as proper areas of study. Importantly, too, his statements, in terms of the lack of clarity of the goals and the objectives of the TVET curriculum, echoed the arguments of Benoit (1974) and Lillis and Hogan (1983). Judging from their perspectives, whatever document was presented as a vocational curriculum was usually afflicted with anarchy (Benoit, 1974) and "a prevailing lack of clarity in aims and intended outcomes" (Lillis & Hogan, 1983, p. 96). This appeared to be the case of the National Examinations Council's (NEC) curriculum.

During Trinidad's post-independence era, the NEC was established by Cabinet in 1965 as "an indigenous institution within the Ministry of Education to address the TVET needs of the country" (Trinidad and Tobago. Ministry of Education [TTMOE], 2002, p. 1). As part of nationalist post-independence fervour for indigenization, the establishment of NEC marked a symbolic change away from foreign examinations conducted by the City and Guilds of London Institute, "whose examinations were accredited by the Board of Industrial

Training (BIT)" (TTMOE, 2002, p. 1). At that time, the then Government's policy was to replace foreign examinations with the local or regional equivalent. Therefore, the Cambridge General Certificate of Education Ordinary Level (GCE O'level) was eventually replaced on a phased basis by the Caribbean Examinations Council's (CXC) Caribbean Secondary Education Certificate (CSEC) General and Basic Proficiency examinations for academic and certain pre-technician subjects. The NEC examinations for specialized Craft and Technician courses took the place of the City and Guilds examination. The NEC was responsible for syllabi, examinations, certification, and other related matters that fell within the purview of TVET programmes in the country (TTMOE, 2002, p. 5).

However, the effective enactment of the NEC curriculum for Craft and Technician programmes used in the senior comprehensive schools was weakened insidiously by a myriad of problems, mainly, the absence of clear goals and objectives in many syllabi and the questionable dissemination of the *correct* content to students. In terms of the welding craft practice, there were peaked levels of uncertainty and a lack of clarity about the syllabi used for the delivery of the subject. The fact that at the secondary level different syllabi were used by teachers raised several issues about the delivery of the subject. Two major documents that Welding TVET teachers relied on for guidance were the Ministry of Education's *National Training Board Craft Training Syllabus: Welding Occupations* (TTMOE, 1984) and the Division of Technical and Vocational Education and Training's *Curriculum Instructional Material (Learning Elements for Welding Class)* (TT. Ministry of Education and Culture [TTMOEC], 1992). In some instances, several teachers applied both documents for guidance in the classroom, while others depended on one. Although both shared similarities in terms of the units and topics, and emphasized a mixture of theoretical and practical work to be taught at schools, there were differences in their aims and objectives. Most importantly, information that related to the specificities of the amount of time that should be allotted to welding practical sessions and the manner in which they should be conducted in the workshop seemed to be sketchy in both documents.

Another area of contention pertaining to the effective delivery of the curriculum centred on the lack of professional development and training for TVET teachers. For Jennings (2012), adequate pre- and in-service training and development for TVET teachers must not be approached from the myopic perspective that "one size fits all." Indeed, TVET teachers are a unique group of educational providers who are expected to "provide academic and occupational instruction while integrating theoretical and hands-on-knowledge and preparing students for the work place" (Kerna, 2012, p. 40). Kerna's research suggests that professional training and development for career and technical education (CTE) instructors should be continuous. In addition, these continuous professional programmes should entail a series of pedagogical training workshops, which must commence with a basic introduction to the terminologies, definitions, and theories of practice in education (Kerna, 2012).

Moreover, the diverse levels of TVET teachers' technical and teaching proficiencies severely undermined their practice in the practical classroom. Many TVET teachers entered the teaching profession with mixed qualifications, skills, and expertise in their subject areas, which hindered in several instances the student-centred competency-based approach to enacting the NEC curriculum. In addition, poor facilities in the workshops prevented the effectiveness of practical sessions. In *The Draft Pre-Feasibility Study for a Technical Vocational Educational and Training Programme* (1993), a survey conducted on 45 secondary schools and two technical institutes revealed that that "about one third (1/3) of all Tec-Voc classrooms, workshops and laboratories are too small … for the present size of classes," and "many rooms are poorly-ventilated" (p. 61). Additionally, workshops in schools have TVET equipment that are not functioning, outdated, and in dire need of repairs (p. 61). Moreover, the survey found that in relation to TVET materials and supplies, the majority of schools lacked adequate funding and resources (p. 61).

Undeniably, critical analysis of students' and teachers' experiences within technical-vocational classrooms is still an under-explored area of research. The somewhat bastardization of TVET within the local arena of education is noted by Campbell (1992), who stated that "it is regrettable that there have been insufficient evaluative studies of technical and vocational input since 1972" (p. 108). Therefore, Lewis's (2009) fervent call for an "epistemological awakening" (p. 558) that promotes the perception of technical-vocational education as more than a means of supplying labour, by acknowledging this area of study as essential in providing experiences that are enriching to curriculum development, should not be ignored.

As former English Language and joint Form teachers of a group of Welding students, we were concerned about our students' continuous pronouncements that the Welding teacher dominated "talk" during the practical sessions. It became a norm to hear the students' say that "*we cyah talk much in de practical*" and "*de teacher directing de show*."

Prior to their concerns, our perceptions were that practical work and student-centred talk were integral features of technical-vocational practical sessions. Their issues challenged our established perceptions, which eventually initiated our investigation into the modes of triadic dialogue used between the Welding teacher and his group of fifth form Welding students. As such, this qualitative case study examined the modes of triadic dialogue that emerged between a technical-vocational teacher and a group of 14 fifth form students at a senior comprehensive school in Trinidad. In addition, it explored the teacher's perceptions of the factors that influenced his teaching during the practical sessions.

Research Questions

We posed the following research questions:

1. *What are the modes of triadic dialogue used by the Welding teacher during the practical sessions?*
2. *What are the teacher's perspectives of the factors that influenced his talk during the practical sessions?*

Methodology

A qualitative case study approach was chosen for this study as we were more curious about "*understanding the meaning people have constructed, that is, how people make sense of their world and the experiences they have in the world*" (Merriam, 2009, p. 13. Italics in original). In other words, it provided us with an opportunity to understand the subjective realities of the participant. The case study tradition was also employed as we wanted to comprehend "a contemporary phenomenon in depth and within its real-life context" (Yin, 2009, p. 18). Furthermore, a purposive sampling strategy (Patton, 1990) was used to select the teacher for this study since we wanted to choose "information-rich cases which we can learn a great deal about" (Patton, 2002, p. 230).

Mr. Paul (pseudonym) was the Welding teacher of an all boys' form class at a senior comprehensive school located in the Caroni Educational District. This senior comprehensive school prepared students for both the NEC and CXC examinations. He had three O'Level passes and a Diploma in Welding from the John Donaldson Technical Institute (1990-1993). In addition, he was pursuing further professional development, namely, the Technical Vocational Teaching Diploma, at the John Donaldson Technical Institute. Prior to entering the teaching profession he had worked as a welding tradesman in a private institution for two years. He entered the teaching service as a Technical-Vocational Teacher 1 (TVT1), and he had at least four years teaching experience in welding at the senior comprehensive school. He was quite eager and committed to engaging in an investigation into his mode of discourse during the practical sessions.

Data collection consisted of non-structured observations. An audio tape recorder was positioned at strategic points in the workshop during the practical sessions. We also jotted down field notes during our five observations in order to ensure that we particularly noted verbal and non-verbal cues, such as changes to intonation, pauses, silences, paralanguage, initiating questions, remarks, feedback and follow-up moves, and concluding remarks. These cues became part of our repertoire of field notes. Follow-up semi-structured interviews after the classroom observations were conducted in order to understand the teacher's perspectives of the factors that influenced his teaching practice. Moreover, semi-structured interviews permitted the teacher to express himself freely and enabled the researchers "to respond to the situation at hand, to the emerging world view of the [teacher]" (Merriam, 2009, p. 90).

Data analysis

All five observations took place in the welding workshop located in the Mechanical Department building at the senior comprehensive school. Although the teacher was observed five times during 90–minute practical sessions, the study focused on data from two of these observations. Both observations were welding tests with dissimilar objectives, processes, and outcomes; however, the teacher's delivery of them was almost the same. Significantly, they were the observations that presented the most social interactions and talk which reflected the terminologies and substantial content that were germane to welding. The data based on classroom observations (Research Question 1) were audiotaped, then transcribed and analysed using Sinclair and Coulthard's (1975) descriptive methodology for three-part discourse, with the addition of Conversational Analysis (Hutchby & Wooffitt, 1999; Pinkevičienė, 2011; Schiffrin, 1994). Our decision to combine both discourse and conversation approaches was influenced by Nunn's (2003) perspective that the nuances and intricacies of classroom talk cannot be fully analysed by any one approach. For Sinclair and Coulthard (1975), lessons can be analysed at levels that take into consideration transactions, teaching exchanges, moves, and acts. This descriptive discourse methodology entailed the coding of the data through the three-part framework that followed the steps of triadic dialogue.

Initiation moves were coded under *teacher informs*, *teacher directs*, and *teacher elicits*. *Teacher informs* included all the instances where the teacher presented concepts, new information, facts, and opinions. *Teacher directs* were occasions where the teacher involved the students in doing something (Sinclair & Coulthard, 1975, p. 50). *Teacher elicits* entailed all verbal exchanges that were intended to obtain students' responses. The manner in which the teacher provided feedback was an important aspect of this dimension. Moreover, responses were the utterances and instances when students performed a task. In addition, follow-up moves were coded into distinct areas of *evaluation*, *accept*, *comment*, and *probe*. *Evaluation* identified teacher's responses that were either assessed as correct or incorrect. *Accept* entailed instances where the teacher acknowledged appropriate responses with markers such as, "*Good!*" "*Very good!*" and "*Yes!*" *Comments* were statements or questions that encouraged students to elucidate, justify, expand, or add new information to their responses. *Probe* captured those occasions when the teacher spent time questioning a student in order to bring him to a better understanding. Furthermore, Conversation Analysis (Hutchby & Wooffitt, 1999; Pinkevičienė, 2011; Schiffrin, 1994) further described the sequential patterns of talk. Moreover, instances of turn-taking, such as the teacher's nomination of students and the students' volunteering of responses, were recorded. Other details that are usually overlooked in terms of conversations, for example, pauses, silences, paralanguage, and changes in intonation were examined. In relation to the second research question, audiotaped interview data were also transcribed verbatim and analysed initially by assigning codes to segments of the data. This coding process was then used to generate categories and themes that were linked to the research question. Finally, the interpretation of the data was presented using rich, thick narrative.

Ethical Considerations

In relation to ethical issues, doing research as insider researchers in our environment is "like wielding a double-edged sword" (Mercer, 2007, p. 12). Our positionality as teachers in the school when this study was conducted meant that we had the advantages of "easy access to the participants, a better understanding of the social setting, a stronger rapport and a deeper, more readily available frame of shared references by which to interpret the data collected" (Mercer, 2007, p. 13). However, there are obvious limitations of insider research, in that information may be held back for fear of being judged (Shah, 2004), and "pragmatism may outweigh candour…[and], preconceptions may colour accounts, because so much is already known (or thought to be known) about the interviewer's opinions" (Mercer, 2007, pp. 14-15). To address some of these ethical dilemmas of insider research we pondered on the information that we should disclose to the participant. We tried, as Platt (1981, p. 80) suggested, "to give some honest and reasonably full account of the rationale and purpose of [the] study…" but without disclosing our views on the issue. In other words, we did not "publicize [our] opinions about [our] research topic" (Mercer, 2007, p. 25). We also engaged in the process of member-checking, which involved taking data back to the participant to ensure that it represented his perspective. Additionally, meetings were held with the Welding teacher to arrange times that were convenient for the observations to take place, and a consent form was given to the teacher and he was assured of confidentiality. Nevertheless, there is the issue that although pseudonyms were given to both the students and the teacher, anonymity is problematic and cannot be guaranteed if the reader knows the school at which the researchers worked (Nespor, 2000).

Findings

Research Question 1

What are the modes of triadic dialogue used by the Welding teacher during the practical sessions?

The findings from the study in relation to the first research question are based on two of the individual classroom observations conducted with Mr. Paul and his class of 14 fifth form Welding students at a selected senior comprehensive school. The students of this particular fifth form class consisted of boys whose ages ranged from 15 to 17 years. The practical Welding sessions were 90 minutes each and took place during the morning sessions in the Welding workshop. The students had to conduct two tests, namely, the Spark Test for Mild Steel and the Peel Test for Gas Welding. The objective of the Spark Test was for students to be able to conduct a spark by placing two pieces of metal through the pedestal grinder in order to ascertain the different chemical reactions. The objective of the Peel Test was for students to be able to perform a deconstructive test in order to check the strength of a resistance spot weld. The findings revealed that both of these sessions, which should have focused on practical hands-on activities, were basically conducted in a theoretical manner. Mr. Paul's role was more of an expert in the classroom where he dominated discourse. The sessions were more based on a teacher-centred approach to learning, where he engaged the students more in the recitation of previous information and regularly evaluated them for the correct answers. Therefore, these observations revealed that triadic dialogue was the predominant type of discourse used by Mr. Paul during both sessions. Moreover, greater monologic applications of the IRE structure took precedence over dialogic engagements of the IRF structure. However, there was one occasion when dialogic discourse emerged from the IRF structure.

Both sessions began in the workshop with a brief whole-class exercise entitled, "Safe Working Habits in the Workshop." This entailed two basic activities:

1. The teacher ensured that all students wore Personal Protective Equipment (PPE), which consisted of long-sleeved coveralls, steel-tip boots, gloves, and goggles, before engaging in the practical exercises.
2. The teacher simulated the manner in which the pedestal grinder is supposed to be operated, and then a student was selected to model the activity.

These exercises began as a whole-class session at the western end of the workshop, where a blackboard and 20 desks and chairs were huddled together in rows and columns near a sequence of spaced concrete blocks that provided limited ventilation to the space. On both occasions, Mr. Paul continuously wiped his face with a handkerchief while the students wiped their foreheads with their palms. The whole-class session continued in the eastern end of the workshop, where welding tools and equipment, such as pliers, a vice, blow torches, a pedestal grinder, and a welder, were clustered near an unventilated corner. In these initial "Safe Working Habits in the Workshop" exercises, triadic dialogue (IRE) was evident. This was observed by the manner in which Mr. Paul began the sessions and when a student was nominated to model his prior simulation of the activity.

Excerpt 1

(1) Mr. Paul: *Alright class, remember what I always say before we begin a practical in my workshop?*

(2) Students: *Yes sir, safety always comes first* [some students answer while others do not].

(3) Mr. Paul: *Good! You have to prevent yourselves from getting burns, arc eyes and shock in here. Let's move on!* [entire class moves to the pedestal grinder at the eastern end of the workshop and they instantly form two rows]. *Naresh go to the pedestal grinder and show us how you should start it* [teacher points to the grinder].

(4) Naresh: *Yes sir* [goes to the grinder].

(5) Mr. Paul: *Good. Remember what you have to do?* [looks directly at Naresh].

(6) Naresh: *Ah tink so* [smiles].

(7) Mr. Paul: *What do you mean yuh tink so!*

(8) Naresh: *Ah only joking, sir* [laughs along with the other students]. *Look! Ah doing it just like you sir* [Naresh simulates the start of the pedestal grinder]. *We have it correct.*

(9) Mr. Paul: *Very good, Naresh. You all remember how to start it?*

(10) Students: *Yes sir* [some students answer while others do not].

(11) Mr. Paul: *Good Naresh! Let's go back there* [points to the desks and chairs]. *Time is going*.

In this excerpt, Mr. Paul dominated talk through his usage of the IRE mode of triadic dialogue. He initiated the exercise with a known information question (KIQ) in Turn 1, "*what I always say before we begin a practical?*", which in Turn 2 elicited a short customary response from the majority of the students. The response in Turn 3 was evaluated and deemed as appropriate based on his affirmation of "*Good!*" Here, the IRE mode of triadic dialogue is used for recitation purposes in order to stimulate the students' memories of the procedure that usually precedes a welding activity. However, Mr. Paul continued with this sequence of triadic dialogue throughout this entire exercise. He established his position as the person in charge of talk through his regulation, selection, and timing of when students should collectively or individually speak. He took charge of turn-taking, spoke the majority of times, and maintained the fast pace of the exercise. This teacher's actions clearly accentuated the ground rules of this asymmetrical type of talk. His role as the authority figure was apparent through his decision-making process, which entailed his nomination of a student (Naresh) and his evaluation of that student's action and response.

The students appeared to be comfortable in their passive roles while the teacher was assertive as he directed the flow of questions and responses. Judging from their previous experiences with this teacher, they knew the type of responses and actions that he expected in "his workshop." These students robotically relied on Mr. Paul's answers rather than engaging in problem solving for themselves. Naresh's statements in Turn 8, "*Look! ah doing it just like you sir*" and "*We have it correct*" highlighted a somewhat systematic and mechanical approach to learning, where mimicry of the teacher's actions and obtaining the teacher's approval seemed to be of paramount importance. It appeared that the students' abilities to fully think critically and creatively were somewhat stifled in this exercise, as opportunities for further discussions were missed. His discourse was monologic as he transmitted information on safety without engaging the students in any discussion. However, from an alternative perspective, this exercise was regularly conducted at the beginning of Mr. Paul's practical sessions; therefore, the familiarity of the topic may not have required intense discussions from the students. As follow-up opportunities for answering questions were not generated by Mr. Paul, his mode of discourse was more in keeping with the IRE approach than the IRF, which makes allowance for follow-up exchanges and discussions for students.

Another example where the IRE mode of triadic dialogue dominated the teacher-student discourse occurred when Mr. Paul directed the students' attention to the use of the relevant tools needed to conduct the Peel Test. This exchange took place right after his session on "Safe Working Habits in the Workshop." The teacher introduced this phase of the task so that the students would comprehend the practical activity.

Excerpt 2

(1) Mr. Paul: *Yes class, look over here you will see a vice and a pliers. How do you use these tools to conduct the Peel Test, Shawn?*

(2) Shawn: *Sir* [pause] *am* [pause again] *we put one end of the sheet metal into de vice.*

(3) Mr. Paul: *Good…but is that all, Lee?*

(4) Lee: *Den pull de other end.*

(5) Mr. Paul: *Yes! But with what, Mukesh?*

(6) Mukesh: *With ah pliers.*

(7) Mr. Paul: *Good….Lets begin now!*

This pattern followed the IRE mode of triadic dialogue. Mr. Paul initiated the discourse in Turn 1 with a known information question (KIQ), with the intention of obtaining a fixed response from a selected student. The student nominated, Shawn, provided Mr. Paul with the fixed answer in Turn 2, which led to the teacher's positive affirmation of "*Good*" in Turn 3. Significantly, Mr. Paul steadfastly progressed with the exact sequencing pattern until the end of the exercise, as noted in Turn 7. Although triadic dialogue was appropriately used to call attention to the task, and was effective in ensuring that the students understood the activity prior to the hands-on exercise, it left no room for open discussions among the participants. Mr. Paul negated opportunities for students' deeper probing and critical thinking skills in terms of other outcomes. Firstly, he could have asked students for other uses of the tools. Secondly, a more open-ended line of questioning would have stimulated further inquiries and discussions into the processes involved in the Peel Test. In this way, the discourse would have become more dialogic through the exchange of ideas and deeper probing.

There was one occasion where a significant change in Mr. Paul's teaching style was evident. This occurred just before the beginning of one of the hands-on activities. At that time, he asked more probing questions and requested more elaboration of students' statements. This encouraged the students to critically think about the objective and the processes involved in the Spark Test.

Excerpt 3

(1) Mr. Paul: *O.K. class these are the two pieces of metal that we are using in order to do the Spark Test. Remember how I said we have to use them?*

(2) Student: *Yes, we pushing it in de pedestal grinder.*

(3) Mr. Paul: *Good Mark! But is it just like that we are pushing it into the grinder you all think?*

(4) Student: *Uum… I think horizontally sir, with de flattest side facing de grinder.*

(5) Mr. Paul: *Thanks Troy, very good. Do you think that is the only way? Anybody can answer.*

(6) Student: *Yes!* [pause] *No!* [pause again] *Now ah not sure. Sir there is another way?*

(7) Mr. Paul: *Uumm! Aah!* [high intonation]. *Remember David what Troy said, horizontally with the flattest side facing the grinder. Come on boys tell me something good.*

(8) Student: *Yes!* [shakes his head up and down] *I think you could do it vertical wise sir.*

(9) Mr. Paul: *Good answer Kevin. Why do you think so?*

(10) Kevin: *I feel both ways are right you know. What is the main ting is dat de metal on de flat side…like de tinnest side first should go into de grinder.*

(11) Mr. Paul: *Good! Good!* [shakes his head and smiles]. *Class, I want you all to remember that both ways are correct and that they do not alter the results of the test. But what do you think will happen if you put the fatter side in de grinder?*

(12) Student: *Nutting.*

(13) Mr.Paul: *You really think so Jevon? After Troy and Kevin said what is important is de flatter side going in. Come on fellas tink* [long lapse].

(14) Student: *It could cause damage.*

(15) Mr. Paul: *Good! Tell me more talk nah man! Don't leave me hanging just so Suresh.*

(16) Suresh: *Ah tink if you put de bigger side first or de fatter side in de machine first it could stick and spoil de machine and it might be kind of hard to hold down de bigger side to push through the grinder, it would not be stable, you might get trouble and it could fly out your hand and hurt somebody.*

(17) Mr. Paul: *Suresh boy yuh right! You all heard what he said? If you put the larger side first into the grinder it can cause damage to you or others and even to the machine. Remember how we started the class with safety first* [smiles].

This excerpt captured the manner in which Mr. Paul positively used the IRF mode of triadic dialogue. During this occasion, his ability to apply the third aspect of the triad, the (F) for follow-up, in a meaningful way allowed him to change the discourse from being monologic to a more dialogic inquiry-based form of teaching. At first glance, his initiation into the discourse followed aspects of the IRE mode of triadic dialogue with his initiation of a KIQ. Although he started with a KIQ, it was deliberately used to call attention to the processes involved in the Spark Test and to commence an inquiry sequence. This was followed by the student's correct answer and, then, his positive affirmation of "*Good Mark!*" However, the structure of his discourse changed when he asked open-ended questions in Turns 3 and 5, and by his statement, "*Anybody can answer*," which invited responses from among the students. His intention here was to investigate how they were thinking about the processes of the Spark Test by having them openly share their views, opinions, and uncertainties. In so doing, he eventually shifted from having an authoritative role in the classroom as the students began taking charge of their learning.

Significantly, Mr. Paul used a plethora of follow-up techniques in order to encourage the students' critical thinking. He used re-voicing or the repetition of a few students' statements in order to get others to internalize information and validate certain concepts, such as "*Remember what Troy said, horizontally with the flattest side facing the grinder*" and "*After Troy and Kevin said what is important is de flatter side going in*." Also, he asked more probing questions to engage the students, for example, in Turn 11, "*But what do you think will happen if you put the fatter side in de grinder*?" In addition, he made requests for further clarification, mainly in Turn 15, "*Tell me more talk nah man! Don't leave me hanging just so Suresh*," which engendered deeper analysis from his students. As some students volunteered responses, others felt at ease to voice their queries. One student even attempted to ask Mr. Paul a question in Turn 6. In this instance, Mr. Paul's use of paralanguage, the high intonation of "*Uumm!*" and "*Aah!*," indicated to the student that he expected more analysis in terms of the question that he had presented. Moreover, the student's response allowed others to think deeply about the process. Significantly, incorrect responses from some students were not openly assessed as "wrong answers"; instead he encouraged the entire class to assess the validity of these responses before moving on to another concept. The variety of techniques applied by Mr. Paul during this instance certainly motivated the students to problem-solve and think critically about the Spark Test. Evidently, during this interval, the ground rules that applied between the teacher and the students fostered more opportunities for talk through open engagement and the sharing of information.

However, during the hands-on activity Mr. Paul still directed all verbal exchanges. This was the only occasion where some students actually participated in the hands-on activity. The instance occurred during the last 20 minutes of one of the exercises. Mr. Paul selected two students, then he asked the other students to stand around the pedestal grinder. These two students were asked to discuss and demonstrate the processes involved in the Spark Test.

Excerpt 4

(1) Mr. Paul: *After you push the metals in what would you notice Nico?*

(2) Nicholas: *Sir plenty of sparks.*

(3) Mr. Paul: *That's right Nico.*

(4) Student: *Fuh real?*

(5) Mr. Paul: *You forgot the lesson that we did already? Nico or Chan go by the grinder and tell Hayden the answer. You all only talking and laughing! I have been watching you all a long time now! I am tired of telling you all to be serious in here! Remember empty vessels make de most noise!* [directs his statements to three boys who were privately talking and laughing with each other].

(6) Chan: *Hayden all of them do not spark up the same.*

(7) Mr. Paul: *Good Chan! You or Nico go and show Hayden* [points to the pedestal grinder].

(8) Nico: *Sir I will do it!* [goes to the grinder and starts putting pieces of metal in it].

(9) Mr. Paul: *Good Nico! Right! What do you see happening here?* [pause].

(10) Student: *S—* [interrupted by Mr. Paul's interjection].

(11) Mr.Paul: *Nico or Chan tell them.*

(12) Chan: *One of the de metals produce small sparks and the other one produce long sparks.*

(13) Student: *But Sir… ah have ah question.*

(14) Mr. Paul: *Just now Kyle. Good Chan! What does that mean Nico? I know you know the answer! You are a bright fella.*

(15) Nico: *Well remember it is a test so de different sparks showing de different amount of carbon in de metal. Their carbon properties are different.*

(16) Chan: *De low speed carbon have 0.2% and de high speed carbon have 1%. De one with more carbon was giving out more longer sparks and de metal with less carbon giving out small sparks. We did it in de lesson on Tuesday.*

(17) Mr. Paul: *Very good! I know you two fellas know your work. You all are not jokers. We will finish on time*.

The IRE mode of triadic dialogue was used during this hands-on activity. The activity began with an initiation question in Turn 1, followed by the selected student's response in Turn 2, then by Mr. Paul's evaluation in Turn 3. In this instance, the IRE mode of triadic dialogue seemed to have a gatekeeping function, as Mr. Paul managed the students' discourse through more rigid selection of nominees and turn-taking. In addition, this mode was used to maintain the steady pace of the activity, which was evidenced by the teacher's strong reliance on the responses and actions of two students, namely, Nico and Chan. They were the students favoured to present their responses, as they were nominated in Turns 1, 5, 7, 11, and 14. Nevertheless, their responses moved the activity forward. Nico demonstrated the activity in Turn 8, while Chan, in Turn 12, explained relevant aspects of the activity. Their combined responses in Turns 15 and 16 discussed the differences in carbon properties between the two metals. At that point, Chan did not wait to be nominated as he confidently continued from where Nico ended his answer. Chan's contribution is particularly interesting as he made the link between the hands-on activity and the theoretical lesson that was taught in the "Tuesday" session. Both Nico and Chan appeared to be quite at ease when responding to the teacher's questions. This excerpt may appear to be dialogic, based on these two students' informative responses and the rapport that they had with each other. However, its discourse pattern is monologic, as Mr. Paul maintained his position as the distributor of questions and the evaluator of responses throughout the excerpt. The element of feedback is definitely missing from the discourse, as Mr. Paul maintained the IRE sequence until the end of the activity although double responses were offered in Turns 15 and 16.

The students' collective responses were evaluated and affirmed as "*Very good!*" by the teacher in Turn 17. It is important to note that other students attempted to ask questions or converse with Mr. Paul but they were overlooked by him as he quickly selected his nominees. Therefore, opportunities for other students' involvement through comments, elaborations, and deeper questioning were absent from the discourse. Here, the IRE mode of triadic dialogue was not used only as a recitation script. Rather, it functioned in a restrictive capacity to serve the needs of the teacher, who selected the two students he felt would have presented the most appropriate answers in less time. In essence, this excerpt displayed features of an authoritative, teacher-centred approach to learning, where there were set answers that Mr. Paul was looking for during the hands-on activity. In addition, he knew the students who would have responded as accurately as possible. As a result, the content from both Nico and Chan was to be accepted without any challenges while Mr. Paul regulated the flow of the talk. There was no interactive whole-class discussion as the other students acted mainly as bystanders, simply listening to and observing the events between the teacher and the two selected students. Many of the students remained voiceless, perhaps intimidated by the teacher's use of the cliché that "*empty vessels make the most noise*."

Research Question 2

What are the teacher's perspectives of the factors that influenced his talk during the practical sessions?

Based on the findings of the second research question, the interview data revealed that several prominent themes emerged, namely, the lack of resources, poor physical conditions, ineffective teacher training and professional development, lack of teacher knowledge and skills, examination structure, and time constraints.

Mr. Paul indicated that a lack of government funding for the provision of resources, such as properly functioning equipment, tools, and materials, influenced his teaching practice, particularly in terms of his practical sessions:

> *You know that we only have one welding machine for the past 20 years and both me and another teacher have to share it. Most of the times as you could see we don't have all the parts for the machine to use it to teach a practical class properly. The foot pedal is stuck right now and sometimes there are power surges that prevents us from using the machine for practical sessions. In the Peel Test we did not even have enough 20 gauge metal sheets. That is why I have to show dem students how to use it. I have to talk more because of this. Sometimes I have only two students do the hands-on practice and then the machine shuts off. At other times I have to show them alone. I complain too but nobody take me on. So I have to teach in de classroom side of the workshop instead.*

Mr. Paul therefore alluded to the negative impact that can ensue when the critical welding machine and the pedestal grinder are either not working or in a deplorable state. This meant that teaching would be more teacher-directed and theoretical, with limited opportunities for students to engage in practical activities.

Additionally, Mr. Paul contended that the lack of materials to conduct his practical sessions affected his classroom practice:

> *You know I would like people to understand, the supervisors, the principal, the Ministry that welding is an expensive craft. It is not like auto-mechanics where you would scrap an engine and then put it back together for another session. Each time I have a class I need fresh materials and I do not get all that I need. Look, for the Spark Test everyone should have had two pieces of material to put into the grinder, but I could not do that, de material was short. Some students get to do it while others do not. So sometimes I try to teach in a way so they could visualize the practical through what I say.*

Mr. Paul highlighted that the limited quantity of materials allocated for his welding practical sessions deeply hinders his ability to conduct the hands-on approach to students' learning. Therefore, he improvises by talking through the practical by focusing on whole-class discussion.

Teacher knowledge and skills was another pivotal factor that influenced classroom practice. Mr. Paul contended that while he had knowledge and skills of most of the content areas of the syllabus, he lacked the knowledge and skills in terms of how to teach in a more student-centred way. However, he admitted that the traditional, teacher-directed approach had worked for him in the past, which resulted in students' success in examinations. Moreover, given time constraints and an examination to prepare for, the traditional approach seemed more commensurate with the classroom realities and context:

> *Most of the times, I understand the content areas of the syllabus. There are some grey areas in the syllabus itself in terms of content but especially in how to teach more student-centred. It states we must do this, but I never really explored it because I don't know it. You know the traditional way, where I in charge, you know where I am the authority, works for me. I have students who are successful in passing the welding exam. In any case we only have two years to teach the subject. So given the amount of work, time is a problem because they have to write an examination, so I have to basically move it along, take control of*

> *discussions as I feel this group work business takes too much time.*

In other words, Mr. Paul also confessed that time constraints predisposed him to take charge of classroom discussion and adopt, many times, a more monologic and didactic approach to teaching so that he could cover all areas of the syllabus in the stipulated time.

Mr. Paul also noted that the pressure of examinations influenced his practice. He further indicated that in Trinidad and Tobago the education system is exam-oriented and that teachers are judged on their examination results. As such, teaching to the test is important:

> *The NEC welding examinations is really a theoretical written test. You know 100% is written. There is no practical exam or even any internal assessment based on the hands-on skills, so I focus on the theory paper. I have to teach what is coming for the exam, so when we have practical sessions and de machines are not working I do whole discussion with class and teach them like if it is a theoretical session and prepare them for the exam. No harm in that the exam theoretical anyway. In we country everything is about passing the exam, we are judged on that.*

Findings also revealed that teacher training and professional development was another salient factor. The training workshops were criticized as being two theoretical, ad-hoc, rushed, top-down and not suited to the needs of the teachers or classroom realities. As such, teachers did not benefit as the workshops were ineffective and vague especially in relation to teaching skills:

> *I really, really feel that most of those training sessions do not really help me you know. Most of the times you sit and listen whole day. You don't have time to actively take part. They really don't show you how to teach, just a set of information. Also is like one big training for everybody. Your individual needs about what you want out of the training don't count. It is one for everybody. Sometimes this don't make sense. Another thing is that it is rushed and sometimes no follow-up immediately or feedback afterwards.*

Discussion and Conclusion

This study presented and addressed two research questions. The findings from the first research question revealed limited opportunities for dialogic talk as the monologic mode of triadic dialogue, the IRE, was predominantly used by the teacher. Its purpose as a recitation script (Haneda, 2005) was appropriately applied in Excerpt 1 when the students were required to recall information that was customary to them. However, its gatekeeper function in Excerpt 2 where the teacher continuously nominated who should speak, and its usage again as a recitation script, arrested the students' opportunities for exploring and exchanging ideas in relation to the test. Gutierrez (1994) contended that in classrooms where activities are strictly based on the IRE mode of triadic dialogue, the students are limited to brief responses to the teachers' questions. In essence, the discourse remained monologic, where the teacher controlled what counted as knowledge as he did not allow the students to elucidate further in terms of the content (Haneda, 2005, p. 314). In Excerpt 4 a more authoritative text unfolded, as the teacher purposely nominated the two students who he believed would have provided the correct answers. Our findings share similarities with Nystrand's (1997) conclusions that many teachers have a tendency to rely heavily on the IRE mode of triadic dialogue in their classrooms. If, as Lucas, Spencer, and Claxton (2012) indicated, "good vocational teachers deliberately seek to engineer rich conversations between learners at different stages" (p. 67), then our findings exposed a dearth of rich conversation-based discussions between the teacher and the students.

There was one instance where the teacher effectively used the third step of the IRF to guide the students' learning. On this occasion, as presented in Excerpt 3, the teacher's follow-up move promoted open sharing of information among the students, opportunities for conversation-based discussions, students' application of critical thinking and problem-solving skills, hesitant moments for deliberation, and further exploration of the content. In this instance, the teacher allowed as many students as possible to answer without much nomination. Significantly, he did not seem to be pressed for time as he allowed the students to provide explanations during their turns.

We argue that the teaching and learning process must become more transformative by relinquishing its tight grip on transmission approaches. In terms of talk, feedback in the form of follow-up is of paramount importance. More specifically, the manner in which it is applied in the technical-vocational arena can create a new dawn for inquiry-based learning during practical sessions, thus allowing vocational students to make substantial contributions to their learning. Unfortunately, one instance of follow-up is insufficient in any classroom if students are to share in the *how*, *why*, and *what* they are learning, moreso, in technical-vocational practical classrooms that are intended to be more activity based. However, the extent to which teachers can capitalize on opportunities for talk depends on a multitude of factors.

The findings that resulted from the second research question disclosed several factors from the teacher's perspective, which, based on his enactment of the NEC curriculum, influenced his talk during the practical sessions. Some of these include the pressures of preparing students for a purely theoretically based examination, the lack of resources for conducting effective practical sessions, the need for ongoing professional development and training for teachers, unsuitable physical classroom conditions, and the lack of knowledge and skills. Our findings shared similarities with Lewin's (1985) and Kerna's (2012) notion that there is need for continuous practical professional development and training for technical-vocational teachers, which includes a balance between theory and practice. Moreover, these instructors must be exposed to concrete teaching strategies from educators, which they can model in their classrooms. In essence, they should be taught the virtues of how to develop their critical thinking, problem-solving, and creative thinking skills as opposed to being instructed on what to teach. This will contribute to their understanding that "vocational pedagogy is then the tactical orchestration of classroom talk, activities, challenges, grouping, available resources, role models and so on" (Lucas et al., 2012, p. 12). While there are factors that are similar across contexts, it is also important to unearth factors that are specific to the local context, as in this case. This study revealed the significant role that examinations play in the society of Trinidad and Tobago; it was touted as a major factor influencing the teacher's talk.

The findings showed the definite need for improvement in terms of the issues presented by the teacher during the follow-up interviews. We argue that improvement in technical-vocational education necessitates injections of time, finances, resources, and astute planning. We further acknowledge that the way forward is not without challenges; however, to address the needs of technical-vocational teachers is indeed a step in the right direction. Unbelievably, the NEC curriculum for schools has been in existence in Trinidad and Tobago since the mid-1970s; however, there are few research studies that investigate its enactment at the secondary level. Importantly, too, this national curriculum has been replaced at the secondary level by CXC's CVQ, which holds the promise of a more lucid curriculum. As a more practical oriented examination, CVQ contrasts with the theoretical emphasis of the NEC examination. We believe that opportunities for engaging in practical classroom research should not be missed as in the case of the NEC curriculum. Although this paper contributes to the field of study on classroom talk, further investigations are necessary in the local context. Many researchers have declared that the IRE mode of triadic dialogue has permitted teachers to control classroom discourse; however, Candela (1998), in her ground-breaking study, contradicted this view. Her study highlighted a reversal in the power dynamic between teachers and students. This interesting slant opens avenues for future investigations into classroom discourse in the Trinidad and Tobago context. In addition, issues pertaining to gender can unearth interesting results. It would be intriguing to find out if the traditional power dynamic of the IRE structure is upheld in technical-vocational practical classes where female teachers predominantly teach female students. Moreover, as this study was limited to one teacher and one class in one school in central Trinidad, a more comparative approach may include schools, classes, and teachers from other educational districts across Trinidad and Tobago. Significantly, diverse follow-up strategies employed by technical-vocational teachers using the IRF mode of triadic dialogue, and their perspectives of the factors that either militate against or effectively facilitate their talk during practical sessions are other areas that warrant further investigation. Overall, the scope of research into classroom talk is expansive and necessitates further exploration in order to enrich the Anglophone Caribbean's research base in this field of study. We suggest that educators consider Lucas et al.'s (2012) notion that

> consistently good vocational education learning environments are full of opportunities for feedback, both from the 'teacher' and, increasingly, from the vocational learner as he or she becomes more and more self-aware and adept at noticing what is going on as he or she learns. (p. 60)

We argue that to improve the quality of practical sessions there is a need to take heed of the quality of classroom talk.

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TRENDS AND ISSUES IN TECHNOLOGY EDUCATION IN THE USA: Lessons for the Caribbean

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This paper traces various developments in technology education at the turn of the 21st century in the USA. It begins by highlighting issues that were being discussed in the 1990s among the technology education community, and the efforts by the science and engineering communities to help shape the content of technology education. The efforts of the International Technology Education Association (ITEA) to create standards for technological literacy in 2000 and supporting standards for assessment and professional development in 2003 are discussed. The recommendations from the report *Technically Speaking* and the impact it had in defining how a technologically literate person is characterized are also presented. This paper also examines the work of the National Center for Engineering and Technology Education (NCETE) from 2005–2012 in spearheading an understanding of how engineering design can be infused in schools, and also how students learn engineering design. The role of pre-engineering curricula in STEM education is examined, and the various curricula that are being used in technology education classrooms since the publication of the *Standards for Technological Literacy* are also traced. Finally, lessons that the Caribbean can learn from the recent evolution of technology education in the USA are discussed.

Introduction

The past decades have seen the world's economy increasingly being driven by technological innovation and an increasing percentage of jobs requiring advanced technological skills. Technology's power as an economic and social force occupied public discussions in many advanced and emerging economies. These conversations have led in some cases to the restructuring of national curricula to address creative and critical thinking, and technological knowledge and processes that are necessary for a 21st century economy. The role of technology as an economic driver, its integrative nature as a knowledge domain, and its ubiquitous presence in the social strata and systems of society have led to intensified efforts in many countries to ensure that the populace is more informed about technology.

Technology is not just the mere artifact, but also involves the knowledge and processes necessary to create and operate these artifacts or products. So technology also includes the engineering know-how and design, manufacturing expertise, technical skills, and the people and organized structure required to produce and use artifacts. Technology by its nature is multi-domain, and curricular endeavours to teach it through the separation of science and mathematics are artificial; serving only the purpose of school organization rather than supporting the dynamic and creative learning needs of students and the practical demands of society (Education for Engineering, 2013). This understanding of technology has gradually influenced much of the school reforms in math and science over the years (Herschbach, 1997). National curriculum endeavours, particularly in the 1990s and thereafter, have seen a shift away from approaching technology education through “different technically oriented syllabi and piecemeal inclusion of technological aspects within science and social sciences” (Compton, 2009, p. 24), to national curricula and standards that address technological literacy. The philosophy is to address technology as a “coherent learning area” with distinct “theoretical underpinning and expectations” for teaching and learning (Compton, 2009, p. 24). The need for technological literacy as an educational outcome for all students is a common consensus in many countries.

Compton (2009) argued that technological literacy serves to enhance democratically aligned educational goals. Through this form of general education, a base is provided for students to understand their existence and potential future role in a wider technological world. National curricula in England, Wales, New Zealand, and Australia are moving away from being prescriptive, to providing strands or frameworks for technology education, with related standards for learning and assessment at all grade levels (see Australian Curriculum, Assessment and Reporting Authority [ACARA]; Compton, 2009; Education for Engineering, 2013; Jones, 2007). Technology education is being viewed as an essential form of literacy for the 21st century, comparable to mathematics, science, and reading. In the USA, after changing its name from *industrial arts* to *technology education* in the 1980s, the technology education field became inextricably enmeshed in the “legacy of industrial arts and its struggle to find curricular direction within the context of competing progressive, essentialist, and technocratic ideas concerning education” (Herschbach, 1997, p. 25).

Trends and Issues in Technology Education in the USA

This article describes significant developments in terms of standards, emerging pedagogical issues, research addressing learning and professional development in technology education, and general practices in K-12 classrooms, as the field attempts to redefine itself by addressing technological literacy development. It traces various developments in technology education at the turn of the 21st century in the USA. The article begins by highlighting issues that were being discussed in the 1990s among the technology education community and efforts by the science and engineering communities to help shape the content of technology education. The efforts of the International Technology Education Association (ITEA) to create standards for technological literacy in 2000 and supporting standards for assessment and professional development in 2003 are discussed. The recommendations from the report *Technically Speaking* and the impact it had in defining how a technologically literate person is characterized are also presented. This paper also examines the work of the National Center for Engineering and Technology Education (NCETE) from 2005–2012 in spearheading an understanding of how engineering design can be infused in schools, and also how students learn engineering design. The role of pre-engineering curricula in STEM education and the various curricula that are being used in technology education classrooms since the publication of the *Standards for Technological Literacy: Content for the Study of Technology* (STL) are also traced. Finally, lessons that the Caribbean can learn from the recent evolution of technology education in the USA are discussed.

A Time for Introspection and Action

Over the years, technology has progressively played an integral role in the lives of Americans. While America's prominence can be attributed to its technological hegemony—particularly in military, business, and industry—at no time in history has technology been so user-friendly and interwoven into the fabric of the day-to-day life of ordinary citizens. Yet, at the latter part of the 20th century, when the information technology phenomenon was rapidly spreading, several stakeholders in technology, engineering, mathematics, and science realized that even as technology become a part of Americans' way of life, it had receded from view; in effect it had become "invisible" (Pearson, Young, National Academy of Engineering [NAE], & National Research Council [NRC], 2002, p. 1). Americans were poorly equipped to address the challenges technology poses or the problems it could solve. While the use of technology was increasing among ordinary citizens, there was no sign of a corresponding improvement in their ability to deal with issues relating to technology (Pearson et al., 2002). Technology is normally seen in a narrow perspective; in terms of its artifacts such as cell phones and computers. Usually, it is not seen in terms of the knowledge and processes necessary to create and operate a wide range of artifacts; the infrastructure necessary for design, operation, and repair; and the organization of personnel necessary to produce these artifacts. What was required was a technologically literate society.

Stirred by the growing need for technological literacy for all citizens, the ITEA (now the International Technology and Engineering Educators Association [ITEEA]) initiated the "Technology for All Americans Project" in 1994, with the aim of providing a formal structure for technology education programmes across the country (Dugger, 2002). The initiative was triggered not only by social, political, and economic discussions, but also out of the struggle by the Technology Education profession to clearly convey its educational purpose in terms that relate to the issues of the day, and to align its programming more closely to the major curriculum perspectives articulated in discussions over the purpose, substance, and form that public education should take (Herschbach, 1997).

The project was three-phased and would culminate in standards that address the learning and assessment of technology education for grades K-12. The project commenced in 1994 and was funded by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). According to Dugger (2002, pp. 96-97), the major deliverables (paraphrased) were:

- **Phase I—Technology for All Americans: A Rationale and Structure for the Study of Technology (RSST, 1994–1996)**. *RSST* established the fact that technological literacy is much more than just knowledge about computers and their application. It defines technology as *human innovation in action* and creates a vision where each citizen should have a degree of knowledge about the nature, behavior, power, and consequences of technology from a broad perspective.
- **Phase II—Standards for Technological Literacy: Content for the Study of Technology (STL 1996–2000).** STL was released at the ITEA conference in Salt Lake City in April 2000. In the review and consensus-building process, more than 4,000 people contributed to the improvement of the document as it was developed and refined, including educators, administrators, and experts from the fields of science, mathematics, and engineering, among others. STL is

endorsed by both the National Research Council and the National Academy of Engineering.

- **Phase III—Companion Standards to *STL* (2000–2003).** The final phase of the Technology for All Americans Project is to develop a companion document for *STL* articulating the standards for assessment, professional development, and programs. The assessment standards are designed to address specific goals and purposes and define who to test, when to test, and what kind of test to use. Professional development standards describe the attributes and skills that teachers should acquire as the result of inservice ongoing education. They apply to every teacher in the schools who is teaching any aspect of technology. And finally, program standards address the totality of the school program across grade levels.

Issues and Concerns Facing the Field

The years leading up to this national initiative were a time for deep reflection on the future of technology education in the USA. Much had happened in the field since its name change from industrial arts to technology education in the 1980s. According to LaPorte (2002), the name change was followed by a flurry of efforts at all levels to articulate just what technology education is and how it might be put into teachable terms. Philosophical and practical arguments ensued in all sectors of the field. Scholarly articles and seminal work at the time echoed the essence of these discussions.

In a study describing present and future critical issues and problems facing the technology education profession, Wicklein (1993) identified curriculum development approach, curriculum development paradigms, lack of consensus on curriculum content, and non-unified curriculum as some critical areas of concern. Another critical area of concern was the need for clarity in what constituted the knowledge base for technology education. Such a formal knowledge base would help in establishing needed precedents for future development within the field. A final critical issue was the concept of interdisciplinary approaches to the delivery of technology education content. The need to integrate technology education with other disciplines was viewed as an essential element for the success of the field. The issues identified in Wicklein's study resonate with the challenges that were inherent to technology education, because of what some viewed as the lack of formal structure; as is the case in other disciplines such as mathematics, economics, or physics (see Frey, 1989; Herschbach, 1995). In addition, technology is interdisciplinary in its use of knowledge, and some opined that "the concept of technology does not lend itself well to a separate subject curriculum orientation," making it difficult "to pin down a definitive structure underlying technology in terms amenable to curriculum development patterned after the academic rationale" (Herschbach, 1997, p. 21).

Technology education researchers have been consistent in emphasizing the non-utilitarian, social dimensions of technology, with many scholarly articles devoted to discussing how technology impacts social structure and conditions; how people live and work; and also how it extends human potential, shape values, and affects the environment (Herschbach, 1997). Custer (1995) addressed the dimensions of technology education. He described technology education as having:

- a human dimension, in that it is a purposeful activity conceived by inventors and planners and can be promoted by entrepreneurs;
- a social dimension, in that it is used and implemented by society, it has effects on society, and it is influenced by value judgments;
- a process dimension, in that it involves doing, making, and implementing with materials; involves design practice and is used to solve problems; is subject to the laws of nature, and may be enhanced by discoveries in science or may often precede science;
- a contextual dimension, in that it is conducted within contexts and constraints;
- and a product dimension, in that it leads to the development of products or artifacts.

Providing a sketch of research in technology education during that period, Zuga (1994) explained that the research base was narrowly defined and inwardly focused, addressing mainly the curriculum. She stated that studies were "primarily descriptive, relates mostly to technology educators' ideas and practices, is concerned with secondary school technology education, and is the result of a small number of researchers working at a handful of institutions" (p. 19). Studies of teachers' attitudes about the curriculum indicated no significant shift from traditional conceptions of industrial arts to more contemporary ideas of technology education. Though some teachers accepted some terminology change, they had not moved very far away from the traditional goals in the field. Zuga also indicated that only a few studies used qualitative methods, and those that did were conducted outside the United States. Other technology education researchers (see Hoepfl, 1997; Johnson, 1995) suggested that technology educators should engage in research that probes for deeper understanding. They also advised that qualitative methodologies provide powerful tools for enhancing understanding of teaching and learning in technology education.

Petrina (1998), in a meta-study of articles published in the *Journal of Technology Education* (JTE), asserted that technology education researchers shy away from situating the field against the backdrop of the politics of education, and in so doing have missed opportunities to bring a critical theory lens to the issues that surround the field. Indeed, Petrina was not alone in his perspectives, as others thought (see Herschbach, 1997; Newman, 1994) that technology education as a discipline was self-absorbed, focusing on the discipline of technology rather than on the mainstream educational issues that were dividing the public, and thus was failing to gain greater recognition by Americans. They suggested that technology education needed to show its capacity to address the prevailing issues if it wanted to gain public support. Petrina identified several framing questions to shape the kind of research that needed to be conducted in technology education. They were:

- How do students, teachers, teacher educators, and the general public come to practice, use, and understand education and technology?
- Toward what end are we committing technology education?
- What is and ought to be the nature of knowledge in technology education?
- How should this knowledge be organized, what ought to be selected for teaching, how should it be taught, and for what end?
- How was technology education practiced in the past?
- How is or was technology education practiced in subcultures and in other cultures?
- Who participates in technology education and why or why not?

According to Sanders (2001), at the beginning of the 21st century, technology education programmes outnumbered industrial arts programmes six to one, with industrial technology programmes claiming most of the middle ground. Practitioners reported teaching problem solving as the most important purpose of the field, supplanting the emphasis on skills development. Three programmes in four were using either the modular technology education or technological problem-solving approach to instruction. Significant demographic shifts transformed the faculty and students of technology education, and the field was reaching a greater range and percentage of students than ever. For decades, the literature has encouraged new content for technology education, and the findings of Sander's (2001) study suggested that communication, manufacturing, construction, and transportation technologies are increasingly represented in the curriculum, with biotechnology represented at a lesser degree despite 10 years of encouragement from the profession. He also indicated that there seems to be continued ambivalence regarding the relationship of technology education to vocational and general education. Despite efforts throughout the 20th century to distance technology education from vocational education, there is considerable evidence of the sort of “border crossings” alluded to by Lewis (1996).

Standards for Technological Literacy

The publication *of Standards for Technological Literacy: Content for the Study of Technology* (STL) in 2000 was a milestone in the professional repertoire of the ITEA, because it marked the first time a national standard was created that provided a framework for technological literacy for K-12. The project extended beyond the mere provision of content standards to later include accompanying standards for programmes, student assessment, and professional development for technology education teachers produced in 2003.

The term *technological literacy* was certainly not a novel phrase among technology educators (Snyder, 2004). The need for technology education for all had been raised as far back as 1948 in the journal *The Industrial Arts Teacher,* when Mr. Walter R. William, the then President of the American Industrial Arts Association (which later became the ITEA) remarked that:

> the pressure of a complex technological society, the narrow view of the manual arts concept is fast giving way to a more comprehensive and flexible interpretation of industrial arts or technology. That a crucial need exists for *technological literacy* is apparent. (p. 1)

Over time, the term became a frequent part of the vocabulary of technology educators and the goal of their professional organization (Snyder, 2004). The term *technological literacy* refers to one's ability to use, manage, evaluate, and understand technology (ITEA, 2000).

The STL consists of 20 technology content standards divided by grade levels K-2, 3-5, 6-8, and 9-12. The standards set forth goals to be met in the five major categories of technology: (a) the nature of technology, (b) technology and society, (c) design, (d) abilities for a technological world, and (e) the design world. Each standard consists of benchmarks, which are statements that enable students to meet a given standard. Benchmarks reflect a:

> progression from basic ideas at the early elementary school level to the more complex and comprehensive ideas at the high school level, and continuity in core concepts across grade levels to ensure the learning of important topics related to a standard. (Dugger, 2002, p. 97)

The STL is not a federal mandate—the standards are voluntary and merely serve as guidelines that states can use to develop K-12 curricula that have the necessary rigour and which address the knowledge, skills, and habits of minds that are essential for the development of technological literacy (Dugger, 1999).

Some will argue that STL, in its comprehensive enunciation of what is required to develop a technologically literate society, addresses some of the issues and questions posed about curricular direction throughout the 1990s. Others may disagree. Nonetheless, the standards produced by the ITEA represented great strides made by the organization to sensitize and institutionalize technology literacy education. The need, however, for more research that focuses on critical elements in technology education was still urgent. In an article published in the *Journal of Technology Education* a year before the STL was published, Lewis (1999b), reiterating some of the concerns raised in previous years by some technology education researchers (see Foster, 1992, 1995; Petrina, 1998; Wicklien, 1993; Zuga, 1994), espoused what he believed were major areas of research needed in technology education. The rationale behind his recommendations was that schools constituted the primary site of inquiry in technology education, so that the ethos of classrooms and laboratories where the subject is taught must be the prime area of focus. Areas of research that needed to be addressed in detail, as seen by Lewis (1999b), were technological literacy and conceptions or misconceptions held by students, perceptions about technology, technology and creativity, gender and technology education, curriculum change and integration, and teacher development.

While the STL was directed at K-12 students, there were other efforts outside of the ITEA that were directed at producing standards that address technological literacy. These efforts targeted undergraduate education, and the technical world provided useful information for the organization of topics. In 1993, the American Association for the Advancement of Science (AAAS) published *Project 2061: Benchmarks for Science Literacy*. The AAAS devoted one chapter to the "Designed World." The focus was the products of engineering and their impact on daily life. Topics covered were agriculture, materials and manufacturing, energy sources and use, communications, information processing, and health technologies. The benchmark recommendations emphasized that technology is a human activity that shapes our environment and lives (AAAS, 1993). In addition, in 1996 the National Academies produced the *National Science Education Standards*. This document contained a section devoted to technology. A notable inclusion was the importance of the design process as a defining aspect of technological endeavors (NRC, 1996).

Technically Speaking

The report *Technically Speaking* was produced after a two-year study, commencing in 2000, by the Committee on Technological Literacy. The committee consisted of a group of experts on diverse subjects, under the auspices of the NAE and the NRC Center for Education. The committee's charge was to begin to develop among relevant communities a common understanding of what technological literacy is, how important it is to the nation, and how it can be achieved. The charge reflected the interests and goals of the two project sponsors—the NSF and Battelle Memorial Institute—as well as the priorities of the National Academies (Pearson et al., 2002). The report was released publicly at a symposium held at the National Academies in January 2002. The report pointed out that technological literacy encompasses three interdependent dimensions—knowledge, ways of thinking and acting, and capabilities—and its goal is to provide people with the tools to participate intelligently and thoughtfully in the world around them (see Figure 1).

The committee reviewed past and present initiatives and made recommendations that addressed four areas: (1) formal and informal education, (2) research, (3) decision making, and (4) teaching excellence and educational innovation. The specific recommendations were:

1. Federal and state agencies that help set education policy should encourage the integration of technology content into K-12 standards, curricula, instructional materials, and student assessments in non-technology subject areas.
2. The states should better align their K-12 standards, curriculum frameworks, and student assessment in the sciences, mathematics, history, social studies, civics, the arts, and language arts with national educational standards that stress the connections between these subjects and technology. National Science Foundation (NSF) and Department of Education (DoEd) funded instructional materials and informal-education initiatives should also stress these connections.

Characteristics of a Technologically Literate Citizen

Knowledge

- Recognizes the pervasiveness of technology in everyday life.
- Understands basic engineering concepts and terms, such as systems, constraints, and trade-offs.
- Is familiar with the nature and limitations of the engineering design process.
- Knows some of the ways technology shapes human history and people shape technology.
- Knows that all technologies entail risk, some that can be anticipated and some that cannot.
- Appreciates that the development and use of technology involve trade-offs and a balance of costs and benefits.
- Understands that technology reflects the values and culture of society.

Ways of thinking

- Asks pertinent questions, of self and others, regarding the benefits and risks of technologies.
- Seeks information about new technologies.
- Participates, when appropriate, in decisions about the development and use of technology.

Capabilities

- Has a range of hands-on skills, such as using a computer for word processing and surfing the Internet and operating a variety of home and office appliances.
- Can identify and fix simple mechanical or technological problems at home or work.
- Can apply basic mathematical concepts related to probability, scale, and estimation to make informed judgments about technological risks and benefits.

Figure 1. Characteristics of a Technologically Literate Citizen (Adopted from *Technically Speaking*, National Academies Press, 2002).

3. NSF, DoEd, state boards of education, and others involved in K-12 science education should introduce, where appropriate, the word "technology" into the titles and contents of science standards, curricula, and instructional materials.
4. NSF, DoEd, and teacher education accrediting bodies should provide incentives for institutions of higher education to transform the preparation of all teachers to better equip them to teach about technology throughout the curriculum.
5. The National Science Foundation should support the development of one or more assessment tools for monitoring the state of technological literacy among students and the public in the United States.

6. The National Science Foundation and the Department of Education should fund research on how people learn about technology, and the results should be applied in formal and informal education settings.
7. Industry, federal agencies responsible for carrying out infrastructure projects, and science and technology museums should provide more opportunities for the nontechnical public to become involved in discussions about technological developments.
8. Federal and state government agencies with a role in guiding or supporting the nation's scientific and technological enterprise, and private foundations concerned about good governance, should support executive education programs intended to increase the technological literacy of government and industry leaders.
9. U.S. engineering societies should underwrite the costs of establishing government- and media-fellow programs with the goal of creating a cadre of policy experts and journalists with a background in engineering.
10. The National Science Foundation in collaboration with industry partners should provide funding for awards for innovative effective approaches to improving the technological literacy of students or the public at large.
11. The White House should add a Presidential Award for Excellence in Technology Teaching to those that it currently offers for mathematics and science teaching. (Pearson et al., 2002, pp. 8–10)

The recommendations reflected the eclectic influence of technology in the lives of all American citizens and the structured actions that were necessary to embrace technological literacy for all. At the same time, the important role that design should play in advancing technological literacy was becoming obvious, as reflected by the various standards on STEM. Research and discussion about the ontology of design and the format it should take in technology education occupied a significant number of research articles post-STL.

Design in Technology Education

Unlike any other curricular endeavour that preceded it, STL points to the importance of a holistic grasp of design when developing technological literacy. It states that:

> to become literate in the design process requires acquiring the cognitive and procedural knowledge needed to create a design, in addition to familiarity with the processes by which a design will

be carried out to make a product or system. (Warner & Morford, 2004, p. 90).

Four of the 20 standards in STL relate to design, and the design theme is woven throughout many benchmarks (Warner & Morford, 2004). Lewis (2005, p. 35) argued that design is the "single most important content category set forth in the standards, because it is a concept that situates the subject more completely within the domain of engineering." The imprimatur of the standards document, in its foreword by the then President of the National Academy of Engineering (NAE), Williams Wulf, reflects confidence at the highest level of the engineering community in the standard's framework to appropriately address important engineering design principles at the pre-college level. Tables 1 and 2 illustrate the design standards and some benchmarks.

Table 1. Design Standards From the Standards for Technological Literacy

Design (Chapter 5)
Standard 8. Students will develop an understanding of the attributes of design.
Standard 9. Students will develop an understanding of engineering design.
Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Abilities for a Technological World (Chapter 6)
Standard 11. Students will develop the abilities to apply the design process.

Table 2. Sample of Design Standards and Benchmarks

Standard 11. Students will develop abilities to apply the design process. As part of learning how to apply design processes, students in grades 6-8 should be able to:
H. Apply a design process to solve problems in and beyond the laboratory-classroom. Perform research, then analyze and synthesize the resulting information gathered through the design process. Identify and select a need, want, or problem to solve, which could result in a solution that could lead to an invention (an original solution) or an innovation (a modification of an existing solution). Identify goals of the problem to be solved. These goals specify what the desired result should be.

I. Specify criteria and constraints for the design. Examples of criteria include function, size, and materials, while examples of constraints are costs, time, and user requirements. Explore various processes and resources and select and use the most appropriate ones. These processes and resources should be based on the criteria and constraints that were previously identified and specified.

J. Make two-dimensional and three dimensional representations of the designed solution. Two-dimensional examples include sketches, drawings, and computer-assisted designs (CAD). A model can take many forms, including graphic, mathematical, and physical.

K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. Testing and evaluation determine if the proposed solution is appropriate for the problem. Based on the results of the tests and evaluation, students should improve the design solution. Problem-solving strategies involve applying prior knowledge, asking questions, and trying ideas.

L. Make a product or system and document the solution. Group process skills should be used, such as working with others in a cooperative team approach and engaging in appropriate quality and safety practices. Students should be encouraged to use design portfolios, journals, drawings, sketches, or schematics to document their ideas, processes, and results. There are many additional ways to communicate the results of the design process to others, such as a World Wide Web page or a model of a product or system.

The inclusion of design, however, raises questions about the difference between technological design and engineering design. Concerns were also raised about what engineering design concepts and processes should be taught in K-12, the preparedness of technology education teachers to teach engineering design, the cognitive processes of students when they solve a design problem, and the appropriate instructional strategies to teach engineering design in response to the new standards (see Lewis, 2005). These all were questions about content and process; however, the focus of most discourses generated in part by these questions primarily centred on the nature of design in technology education.

Research focusing on design post-STL included that by Custer, Valesey, and Burke (2001), which validated an instrument for assessing student learning in design and problem solving. Warner and Morford (2004) provided evidence that design in the curriculum content experienced by pre-service technology teachers during their undergraduate studies was deeply rooted in the technical aspects of the design process, without much emphasis on design concepts. Lewis (2005) addressed the adjustments that need to be made within technology education for the field to come to terms with engineering as content. He opined that these adjustments must not be limited to curriculum and instructional strategies, but must necessarily impact inquiry and teacher preparation methodologies.

Other types of curriculum and pedagogical conceptualizations also influenced the discourse about the structure of design in technology education. These curriculum concepts included an integrative approach to design that incorporates mathematics and applied science, in keeping with the cross-cutting nature of engineering (Roman, 2001); a proposal that mathematical theories be applied to design in technology education classrooms to encourage students to use mathematics to predict the outcomes of their designs (Cotton, 2002); and suggestions that students spend more time engaged in research and redesign activities (Neumann, 2003).

Against the backdrop of an economy that demanded more students in STEM disciplines who are critical thinkers and innovative problem solvers, more educators were searching for engaging curricula that integrate STEM to achieve these educational outcomes. The STL was gradually being accepted by an increasing number of states to guide the development of technology curricula for K-12. More STEM educators were also recognizing the potential of design, particularly engineering and technological design, to provide engaging scenarios that allow students to apply knowledge from science, mathematics, technology, and engineering to solve authentic problems. The establishment of a Center for Learning and Teaching (CLT) by NSF would prove to be instrumental in promoting an understanding of how engineering design can be infused in K-12 schools.

The National Center for Engineering and Technology Education (NCETE)

The NCETE was established on September 15, 2004, and was funded by the NSF as one of the 17 CLTs in the country. The Center comprised a strong team of partners from nine universities and four professional organizations. The university partners were Brigham Young University; California State University, Los Angeles; Illinois State University; North Carolina A&T State University; University of Georgia; University of Illinois at Urbana-Champaign; University of Minnesota; University of Wisconsin-Stout; and Utah State University. The professional society partners were the International Technology and Engineering Educators

Association (ITEEA); the American Society for Engineering Education (ASEE); the Council on Technology Teacher Education (CTTE, now Council on Technology and Engineering Teacher Education (CTETE)); and the Center for the Advancement of Scholarship on Engineering Education (CASEE).

According to Hailey, Erekson, Becker, and Thomas (2005, p. 23), the ultimate goal of NCETE is to infuse engineering design, problem solving, and analytical skills in K-12 schools through technology education, and to increase the quality, quantity, and diversity of engineering and technology educators. Engineering faculty and technology educators collaborated in a systematic way to accomplish the following:

1. Build a community of researchers and leaders to conduct research in emerging engineering and technology education areas.
2. Create a body of research that improves our understanding of learning and teaching engineering and technology subjects.
3. Prepare technology education teachers at the BS and MS level who can infuse engineering design into the curriculum (current and future teachers).
4. Increase the number and diversity of students selecting engineering, science, mathematics, and technology career pathways.

The formation of NCETE represented in part a direct response to the ongoing discourse about the format that engineering design should have at the high school level. One of the goals of NCETE was to work with engineering and technology educators to prepare them to introduce engineering design concepts in Grades 9-12. Comparing the mission of the Center with the requirement of the STL, Hailey et al. (2005) further enunciated that the design process described in *Standard 8* is very similar to the introductory engineering design process described in freshman engineering design textbooks. The exception exists in the teaching of analysis in freshman engineering programmes as the decision-making tool for evaluating a set of design alternatives, where "analysis" means the analytical solution of a problem using mathematics and principles of science (p. 25).

Introducing students in Grades 9-12 to the role of engineering analysis in the design process positions technology education more in the realm of engineering, and also increases its value as a knowledge domain that integrates mathematics and science—thus strengthening the STEM connection. NCETE's website displays over 150 studies and numerous outreach activities accomplished by the faculty and graduates of the

Center and its nine partnering universities from 2004–2012 (see http://ncete.org/flash/publications.php), which directly relate to its mandate to infuse engineering design problem solving and analytical skills in schools. Areas addressed by these studies and outreach activities include:

- Feature of engineering design in technology education
- Professional development of technology teachers to teach engineering design
- Teaching engineering concepts
- Creativity
- Cognitive processes in design problem solving
- Integrating mathematics and science in engineering and technology education
- Assessment in design
- Engineering challenges

Table 3 highlights dissertations published by doctoral fellows of NCETE.

Table 3. List of NCETE Fellow Dissertations

Austin, C. (2009). *Factors influencing African-American high school students in career decision self-efficacy and engineering-related goal intentions* (Unpublished doctoral dissertation). University of Minnesota, Minneapolis.

Avery, Z. K. (2009) *Effects of professional development on infusing engineering design into high school science, technology, engineering and math (STEM) curricula* (Unpublished doctoral dissertation). Utah State University, Logan.

Daugherty, J. L. (2008). *Engineering-oriented professional development for secondary level teachers: A multiple case study analysis* (Unpublished doctoral dissertation). University of Illinois at Urbana-Champaign.

Denson, C. D. (2008). *Impact of mentorship programs to influence African-American male high school students' perception of engineering* (Unpublished doctoral dissertation). University of Georgia, Athens.

Dixon, R. (2010). *Experts and novices: Difference in their use of mental representation and metacognition in engineering design* (Unpublished doctoral dissertation). University of Illinois at Urbana-Champaign.

Franske, B. (2009). *Engineering problem finding in high school students* (Unpublished doctoral dissertation). University of Minnesota, Minneapolis.

Kelley, T. (2008). *Examination of engineering design in curriculum content and assessment practices of secondary technology education* (Unpublished doctoral dissertation). University of Georgia, Athens.

Lammi, M. (2010). *Characterizing high school students systems thinking in engineering design through the function-behavior-structure (FBS) framework.* (Unpublished doctoral dissertation). Utah State University, Logan.

Mentzer, N. (2008). *Academic performance as a predictor of student growth in achievement and mental motivation during an engineering design challenge in engineering and technology education* (Unpublished doctoral dissertation). Utah State University, Logan.

Roue, L. (2011). *A study of grade level and gender differences in divergent thinking among 8th and 11th graders in a mid-western school district* (Unpublished doctoral dissertation). University of Minnesota, Minneapolis.

Stricker, D. (2008). *Perceptions of creativity in art, music and technology education* (Unpublished doctoral dissertation). University of Minnesota, Minneapolis.

Walrath, D. (2008). *Complex systems in engineering and technology education: The role software simulations serve in student learning* (Unpublished doctoral dissertation). Utah State University, Logan.

Source: http://ncete.org/flash/publications_dis.php

NCETE's final report to NSF in 2012 identified the lack of a clear disciplinary standards-based home for engineering design experiences as the main challenge that faces professional development of technology education teachers. The report also mentioned that the infusion of engineering design into high school courses is scattered across mathematics, technology, and science, and there is a considerable quantity of curriculum material available to guide teachers and professional developers. The report further added that presenting students with opportunities to engage in engineering design requires a paradigm shift from the traditional classroom environment to one where teachers establish an environment that encourages students to take ownership of the engineering design challenge, identify needs or wants that are personally important or relevant to them, frame the design problem with applicable criteria and constraints, generate alternative solutions, evaluate competing ideas, and carry out the testing of prototypes.

Concurrent developments in engineering education organizations, such as moves to embrace engineering content at the K-12 level, coupled with the implementation of structures to develop and support teachers in the delivery of this content, also impacted technology education. For example, in 2003 the American Society for Engineering Education (ASEE) added the K-12 Division and initiated K-12 workshops at the 2004 ASEE conference. In 2006, the National Academy of Engineering (NAE) established the Committee on K-12 Engineering Education to explore K-12 engineering curricula and instructional practices (NCETE, 2012).

Indubitably influenced by the national context and ongoing developments in engineering education associations and professional bodies, the ITEA changed its name to the International Technology and Engineering Educators Association (ITEEA). In a release to the technology education community in March 2010, the ITEEA stated in part:

> This change causes the association to immediately address curriculum and professional development that includes both technology and engineering education at the K-12 level. The association's membership has been comprised of teachers who have been working in both areas and with many of its affiliates already having "engineering" in their association's title.
>
> The term engineering is not new to the technology teaching profession; it has been used for over a century in various course titles, discussions, and curriculum efforts. The engineering community played a key role in the creation of this subject area as it has gone through various name changes as industry and technology have changed.
>
> The name change properly positions the association to deal with the 'T' & 'E' of a strong STEM education. ...ITEEA's continuing initiatives with the Engineering by Design™ curriculum work further add to the promotion of technology and engineering at the K-12 school level…

Since the name change to ITEEA, other events at the national level pointed to deliberate efforts to include engineering content in K-12 schools. In 2011, 12 states included engineering in science standards and one in mathematics standards. Nineteen states included engineering related to standards promoted by ITEEA or "Project Lead the Way" (NCETE, 2012). The 2012 *Framework for K-12 Science Education* stated that engineering and technology would be part of the new science standards. The National Assessment of Education Progress (NAEP) includes technology and engineering literacy in its 2014 assessment as distinct literacies.

Pre-Engineering and STEM

A description of the trend in technology education would not be complete without addressing other curricular trends that have influenced technology education. In 2004, Lewis argued that the phenomenon of pre-engineering was the most recent claimant to the technology education tradition. He reasoned that:

> while it constitutes an epistemological advance, pre-engineering also represents a decided sociological calculation, that hopes to make the subject more palatable to the tastes of the academics who run schools, and the middle and upper classes, whose children turn away from the base subject after the compulsory stages in the middle grades, as they fix their attention on the college track, and upon professional careers. (p. 22)

Lewis spoke about four conceptions of pre-engineering, identifying them as:

- Career academy conception – Academies are intended to bridge the gap between academic and vocational education. Programs prepare students both for two and four-year colleges by combining a college preparatory curriculum with a career theme and courses that meet high school graduation and college preparatory requirements.
- Magnet school conception – Magnet schools are district-wide specialty schools, which emerged as a means of desegregating school systems. One curricular approach is to focus these schools around particular themes. Parents send their kids to these racially mixed schools with the prospect of exposing them to innovative curricula.
- Regular conception – This refers to the curriculum initiatives that infuse engineering design in the context of manufacturing, construction, transportation, communication, power and energy, and management – the core areas of technology education.
- Movement conception – A version of pre-engineering that uses a course sequence option that sets the stage for possible enrollment in engineering programs in two and four-year colleges.

These conceptions tend to adopt a curricular structure that uses a particular discipline, such as science or mathematics, as a platform for the integration of engineering and technology; or technology and engineering to integrate mathematics and science concepts. Curricula associated with these pre-engineering conceptions have emerged to represent exemplar attempts to integrate STEM. Brophy, Klein, Portsmore, and Rogers (2008) described some of the more popular curricula in use at elementary and high schools.

Project Lead the Way

Some view the "Project Lead the Way" (PLTW) curriculum as exemplary in providing high schools with pre-engineering activities and linkages to college-level engineering and engineering technology programmes (Bottoms & Anthony, 2005; McVearry, 2003). PLTW is a non-profit organization that works with public schools, the private sector, and higher education to increase the quantity and quality of engineers and engineering technologists, by giving students the opportunity to design solutions to various problems. They offer a multi-year problem-based/project-based curriculum that has been adopted by over 1,400 schools (7% of all U.S. high schools) in all 50 states and the District of Columbia (Tran & Nathan, 2010). Curricula are provided for both middle and high schools. The middle school curriculum introduces students in Grade 6 through 8 to the broad field of technology. The standard-based pre-engineering curriculum, *Pathway to Engineering*™, is designed for high schools. It challenges students to solve real-world engineering problems by applying their knowledge and skills in mathematics, science and technology.

In the state of Massachusetts where this curriculum has been adopted, engineers advocate for the importance of technology education, resulting in it being viewed as high-status and the state conceiving the subject as a derivative of engineering and so framing it in tight connection with science. According to Lewis (2005):

> Throughout the grades, the curriculum guide takes an engineering slant. In grades 3-5, students learn about tools and materials, and are expected to display "engineering design skill" by finding and proposing solutions to problems, working with a variety of tools and materials. In grades 6-8, students are expected to "pursue engineering questions and technological solutions that emphasize research and problem solving." In the grades 9 and 10 they take a full year technology/engineering course covering engineering design; construction technologies; power and energy technologies in fluid, thermal and electrical systems; communication technologies; and manufacturing technologies. In grades 11 and 12 students can take advanced courses such as automation and robotics, multimedia, and biotechnology. At this level there is a strong engineering careers focus, with course sequences available for students intending to pursue engineering programs at the college level. (p. 32)

Teachers in Indiana also embraced the PLTW curriculum, seeing it as a valuable component of technology education and beneficial for technological literacy (Rogers & Rogers, 2005). The state has the highest per capita inclusion of PLTW in the nation. The curriculum is included in the State's technology education curriculum, and PLTW teachers are required to hold a technology education teaching licensure (Rogers, 2006). In a study conducted among technology education teachers, Rogers (2006) concluded that Indiana's PLTW teachers perceive all the courses in the PLTW curriculum as being effective in developing pre-engineering competencies in their high school students. Figure 2 illustrates some of the curricula that are used at the middle and high school levels to develop technological literacy through a pre-engineering focus.

Pre-Engineering Program	**Description**
Engineering by Design (EbD)	The International Technology and Engineering Educators Association's STEM Center for Teaching and Learning™ has developed the only standards-based national model for Grades K-12 that delivers technological literacy. The model Engineering by Design™ is built on Standards for Technological Literacy (ITEEA); Principles and Standards for School Mathematics (NCTM); and Project 2061, Benchmarks for Science Literacy (AAAS). The EbD is used in many school districts in the USA to teach to the STL.
Engineering is Elementary (EiE)	This is one of the largest elementary engineering curriculum development projects. It focuses on integrating engineering with reading literacy and existing science topics in the elementary grades. It was originally developed at the Boston Museum of Science to meet new engineering standards like those defined by Massachusetts. EiE is aligned with national and many state standards and integrated with science, language arts, mathematics, and social studies. Some pre-service teacher education programs use these materials in their courses. EiE also provides in-service professional development for educators who want to implement the curriculum.
LEGOengineering	This is the most prominent project of Tufts Center for Engineering Education Outreach. The center initially selected the LEGO material to implement the majority of its engineering efforts at the K-12 levels as well as at the college level, because of their ease of use as well as their power to enable students in hands-on engineering design. The

	LEGO toolkit gives students the opportunity to design solutions to various problems, while still allowing them to make changes with their design. They can create working products of significant complexity while still remaining open-ended. The LEGOengineering-inspired books and activities help to give educators at the elementary, middle, and high school /college level basic activities to bring engineering into the classroom and teaching engineering content.
The Infinity Project	The Infinity Project was developed in 1999 by the Institute for Engineering Education at the Southern Methodist University, Texas Instruments working in partnership with the U.S Department of Education, the National Science Foundation, and others. It brings the theme of technology literacy and engineering into middle and high schools through a curriculum that focuses on advanced topics in digital signal processors (DSPs), including the internet, cell phones, digital video and movie special effects, and electronic music.
Vanderbilt Instruction in Biomedical Engineering for Secondary Science (VIBES)	VIBES started in 1999. The project was funded through the National Science Foundation‘s Vanderbilt – Northwestern-Texas-Harvard/MIT Engineering Research Center (VaNTH ERC). Vibes consists of learning modules to teach a high school level engineering course, a physics course, or portions of an anatomy or physiology course. Teachers participating in VIBES must be teaching a relevant course and have approval from their home school to participate in VIBES workshop.

Figure 2. Examples of pre-engineering curricula.

The strong design focus of PLTW and other curricula highlighted in Figure 2 reflect the emphasis on creative problem solving. *Standards for Technological Literacy* emphasize the use of problem-solving strategies in teaching to enhance creativity. Design is ideal for creative thinking because of its open-endedness and the fact that there is more than one possible answer and more than one method of arriving at a solution (McCormick & Davidson, 1996). Design also requires students to use analogical reasoning and divergent thinking processes—cognitive processes that enhance creative abilities (Lewis 2005).

A Picture of What's Happening in Schools

Articles appearing in the *Technology and Engineering Teacher* Journal (formerly *The Technology Teacher*) help to paint a picture of what technology education teachers have been accomplishing in the classroom. The four-year period from 2008 to 2012 saw the emphasis on design and integrative STEM. For example, Frazier and Sterling (2008) related how they used "motor mania" as a topic to let students experience at first hand the relationship between science and technology applications, such as getting a car to function well. This problem-based learning activity takes middle school students through the various stages of the design process to solve a technological problem. The learning engagements provide a means for students to function as scientists and engineers as they work towards solving a specific real-world problem situation with technological design. Verma, Dickerson, and McKinney (2011) demonstrated how an innovative project-based curriculum, "The Marine Tech Project," helped students to learn about ship design, construction, ship operations, and ship stability concepts.

Sanders (2009, p. 23), addressing the importance of integrative STEM in technology education classrooms, said that it "provides a context and framework for organizing abstract understandings of science and mathematics and encourage students to actively construct the contextualized knowledge of science and mathematics, thereby promoting recall and learning transfer." There are also accounts of teachers implementing integrative STEM in their own courses. Silk, Hagashi, Shoop, and Schunn (2010) spoke about designing and redesigning robotics units to teach mathematics. Bellamy and Mativo (2010) discussed using real-life situations in the technology education classroom to teach mathematics, and Gathing (2011) illustrated how mathematics can be integrated into technology classes by using bridge design in the teaching of trigonometry.

Other articles in the *Technology and Engineering Teacher* journal also illustrate how integrative STEM is being introduced in technology education through teachers working across disciplines. For example, Pendergraft, Daugherty, and Rossetti (2009) spoke of how the English language learner programme at the Engineering Academy at Springdale High School, Arkansas used engineering design activities to introduce students to the open-ended and multidisciplinary nature of engineering. The challenging design problems provided students with opportunities to apply the science, math, and technology concepts they had been studying in their associated classes. Piotrowski and Kressly (2009) spoke of the benefits of cooperative classroom robotics, which bring teachers from mathematics, science, and even English, to the technology education lab. Lawrence and Mancuso (2012) explained how girls' awareness and interest in engineering are promoted in the "Girls Excited about Engineering, Mathematics and Computer Science" (GE2McS) NSF initiative in schools. Brown, Brown, and Merrill (2012) explored possible ways in which mathematics, science, and technology education teachers could collaborate in teaching biotechnology, medical technology, and engineering. The journal contains numerous examples of exemplary teaching and curriculum that address robotics, CNC machining, communications technology, nanotechnology, medical technology, alternative energy, green technologies, construction technology, design challenges, and animation/ simulation in design.

Despite the role that technology education teachers at the middle and high school level are playing in integrating STEM, particularly through technological and engineering design, in a survey study conducted among supervisors in school districts across 50 states, Moye, Dugger, and Starkweather (2012) found that technology and engineering teachers are not being counted in major state STEM initiatives. Technology teachers are either non-existent or loosely counted in many databases. They go on to add that states often see "STEM" as what mathematics and science teachers do. They recommend that emphasis must be placed on ensuring that technology education teachers are also included in this group.

The progression of technology education in the USA for the past 20 years reflects the gradual acceptance for technological literacy to be delivered as general education. To that end, national standards have been produced for all grade levels. While technology education is still not a compulsory curriculum, its role in teaching integrative STEM is recognized by many in mathematics, science, and engineering education. The decision to include standards that address science and engineering practices; engineering design; and science, technology, society, and the environment, in the new *Next Generation Science Standards* (Achieve, Inc., 2013) for K-12 schools is indicative of how closer to this realization the nation has come.

Lessons for the Caribbean

The Caribbean can learn from these efforts to produce technology standards to ensure that its citizenry is also characterized by technological literacy. Indeed, this cannot be overemphasized in a world where technology is becoming pervasive at every level of society. The Caribbean as a region, however, will lag behind other nations in producing a technologically literate society if regional initiatives are not taken to develop frameworks through which this can be achieved. I will now—without being prescriptive—articulate some broad approaches that are needed in the Caribbean to address technological literacy from the primary to the secondary level of the educational system.

Technological Standards for the Region

For the Caribbean region to remain competitive in the present, and also in a future global economy, the region must move beyond viewing general education as being defined only by the language arts, mathematics, and the sciences. Literacy must also encompass understanding the nature of technology, and every student from the primary to the secondary level must be exposed to systematic, age-appropriate curricula that allow this to be achieved. To attain this egalitarian goal, there must be standards that govern the content of technology that is taught at the primary and secondary levels throughout the region. The establishment of such standards will provide guidelines for technology teaching practice and an evaluative framework, which will ensure that the region is producing secondary school students with the technological foundation to be successful in postsecondary education (academic or vocational), and who are also ready for entry-level positions in advanced technology industry. In the long term, the region's populace will be characterized by high levels of technological competency. Visions of a common economic region only accentuate the importance of such standards; without which parity in technological outcomes among the islands will be difficult to guarantee.

Technology literacy standards must be driven by a socio-economic analysis of the region's technological infrastructure, which should produce a classification of core technological areas for learning from the primary to the secondary level. For example, the STL classified five core technological areas in which students in the USA should be literate—energy, transportation, manufacturing, communication, and construction. Similarly, such a classification is required for the Caribbean region. Indeed, Girvan (2007) might have inadvertently identified some aspects of this classification when he identified energy, manufacturing, and agriculture as some of the main economic drivers of Caribbean regional development. Regional efforts, however, must be invested in research to define these core technological areas and the relevant standards that govern their learning. This must be followed by policies instituted by the regional ministries of education to develop curricula, student assessments, and teacher development programmes to meet the requirements of these standards from primary to secondary levels (Dugger, 1999).

Standards have the capacity to influence change in the fundamental delivery mechanism of the educational system. Standards for technological literacy—as general education—that have the endorsement of the education ministries in the Caribbean, can influence how education is delivered at the primary and secondary levels. The following are three ways in which this might be possible.

First, the existence of a standard document for technological literacy for primary education will influence the development of curricular materials, methods of assessment, teacher education and development programmes, as well as infrastructural changes to ensure that the outcomes relating to these standards are achieved. One way in which colleges can address technological literacy requirements at the primary level is to have integrative STEM teacher education certification programmes. The basic nature of technology required at the primary level should not make this difficult to achieve at teacher training colleges. The indigenous materials available in the Caribbean, as well as the plethora of computer-assisted learning educational software that can allow students to explore math, science, and technology, are resources that can be used to enrich the learning of STEM at the primary level. Off-the-shelf, low cost, and low maintenance equipment are also available, which provide educational engagements requiring scientific inquiry, mathematics, and technological problem solving. Dugger (1999) offers some useful insights into technology learning at the primary level. He indicated that technology at the elementary level involves much more than products and computers. Technology has its own intellectual domain, which every student should learn along with science, mathematics, language arts, and social studies. Lewis (1999a) also added that technology education in a poor country cannot be premised on the same content as in affluent countries, but technology in schools must be concerned with exciting and delighting children. The key is to foster interest in careers with a technological focus by allowing students to have opportunities to engage in rich technological experiences from an early age (ACARA, 2012).

Second, the secondary entrance assessment (known as GSAT in Jamaica and BSSE in Barbados) that is used each year in some islands to place students in secondary schools should also assess for technological outcomes. This will ensure that students enter secondary education programmes with the required technological foundation.

Third, technology literacy standards for secondary level must also include a progression in the development of engineering outcomes.

Engineering principles, engineering design, material science, and other relevant engineering focus must also be addressed in such a document. Having a consistent framework to guide secondary teachers throughout the Caribbean will help to assure the general public that students possess the technological foundation to advance into various STEM fields at the college level. A solid foundation will also be provided for students who choose technical and vocational areas. The Caribbean Secondary Education Certificate (CSEC) and the Caribbean Advanced Proficiency Examination (CAPE) can use these standards as a framework to assess for technological outcomes.

A Note on TVET

While standards that govern technological literacy are very important for primary and secondary level education, this does not somehow negate the need for occupational standards to ensure that Caribbean students are acquiring specific job competencies at the appropriate proficiency while they are still in secondary school. Both standards used in synergy will produce a technologically literate and technically competent populace; technological standards will ensure that general proficiency in technology is achieved, while occupational standards will ensure that students achieve specific job competencies for targeted occupational areas. The latter standards are derived from job or occupational analysis normally carried out by the Councils of Technical and Vocational Training in the respective islands that have such an institution. In fact, for some years now, Caribbean Vocational Qualifications (CVQs) that serve to standardize skills expectations across the region have been in existence (Lewis, 2007).

Much can be learned from Newly Industrialized Countries such as China and Korea, which share a new vision of the role of technical and vocational education and training (TVET), seeing it as equally important to equip students with the life skills of the 21st century (UNESCO, 2005). In these countries, increasing numbers of secondary school students are enrolled in TVET programmes that have a strong academic focus. In some schools, academic and vocational students share 75% of a common curriculum (Lewis, 2007). Regardless of the configuration used, the salient point is that TVET must be an integral part of the regional strategy to develop a technologically capable, equitable, and sustainable region.

The institutional infrastructure of the islands in the Caribbean necessitates that a diverse approach to delivering TVET be used. For example, secondary schools can partner with TVET agencies, community and technical colleges, and private enterprises to deliver the first level (Level 1) of TVET qualifications. Level 1 programmes can be delivered at secondary school campuses as joint endeavours between secondary schools and national training agencies. Facilities at community colleges or training centres can also be used if secondary schools do not have the infrastructure. With this approach, students can concurrently complete vocational curricula, while completing Grades 9-11of the technology standards, to be ready for entry into the workforce. An obvious advantage of using this configuration is that students can meet standards for entry into particular technical occupations before completing secondary school. This would help to minimize expenses that companies accrue from training workers in entry-level technical skills, and lead to the diversion of these resources to advanced technological training. Such a partnership between schools and training agencies can result in access to facilities, equipment, and other resources that normally would be difficult for the schools because of budgetary constraints. Moving Level 1 TVET programmes into secondary schools will strengthen the collaboration among schools, industry, and TVET agencies. Industries and TVET agencies will have more influence in school curricula and administration. Industry, in particular, could provide opportunities for apprenticeship placements, scholarships, and their personnel can serve on school boards, and advisory committees.

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MAKING TVET RELEVANT TO A POSTMODERN CARIBBEAN

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We live in a postmodernist society where there is greater acceptance of diversity and complexity, and recognition that multiple viewpoints can coexist in an era that is characterized by uncertainty and rapid changes. Consequently, TVET programmes cannot function effectively unless there are major reforms that can prepare students to better meet the needs of the postmodern work environment. This paper argues for some of these changes. The prevailing notion that TVET is a viable refuge for those who are not "academically inclined" is exposed in this paper as a myth, which has no support in the actual workplace, where scientific principles must be applied by workers in order to create, take decisions, and solve problems. Technological developments have made the workplace more demanding of autonomous workers who can take decisions without waiting for instructions. Hence there is need for greater integration of academics with TVET to widen the understanding of TVET students in preparation for these roles. If adopted, the reforms recommended in this paper can go a long way in preparing a workforce capable of meeting the challenges of the postmodern work environment and raise the social acceptance of TVET as well.

Introduction

In earlier times, it was possible for some workers to practise an occupation in the same manner over a lifetime, because changes in the essential aspects of the occupation were slow in coming. Because of the rapid growth of technology and changed public expectations today, there must be continuous curriculum changes in order for education and training curricula to be relevant. Public expectations have moved from a traditional and modernist world view, which relegated technical and vocational education and training (TVET) to a secondary role; to a postmodernist perspective that is more accommodating and equitable (Rust, 1991), and where much more is expected from workers than the performance of repetitive operations. Postmodernism radically reduces the hierarchical distance between white-collar and blue-collar work, and between academic studies and TVET. This paper will define TVET, discuss the nature of the postmodern society, and suggest changes that must take place in TVET in order to be relevant in a postmodern Caribbean society.

At the Second International Congress on TVET in the Republic of Korea, it was accepted that TVET is most directly concerned with the acquisition of the knowledge and skills required for the world of work, formal and informal, urban and rural (UNESCO, 1999, p. 27). Historically, TVET has been an important contributor to Caribbean development. In earlier times, when communication with the developed world was infrequent and uncertain, local people had to fabricate parts and undertake repairs using very basic tools and individual creativity. Many of the innovations that emerged from the relatively primitive workshops in existence at the time satisfied needs that were encountered, mainly in agriculture and transportation. Later on, there was widespread introduction of formal apprenticeships, where the importance of integrating the scientific underpinnings with the practical operations of various work-related situations was recognized, and technical classes were incorporated into apprenticeship programmes. For example, apprentices at Shell Trinidad Ltd. had three days of field work and two days of classroom studies in mathematics, English language, and technological studies.

In those days, the graduates from apprenticeships possessed an occupational identity and demonstrated mastery over work situations. With the onset of Independence, apprenticeship declined in many Caribbean countries to give way to institution- and school-based TVET, where training took place in isolation from the workplace. Furthermore, the emphasis continues to be on developing the skills required by employers with very little being done to develop the trainees as living human beings, with individual dreams and aspirations, who must be capable of participating in the processes of democratic societies and interacting satisfactorily with clients and fellow workers.

The Postmodern Society

Rust (1991) characterized the modernist perspective as having a single world view, whereby privileged groups maintain perpetual ascendancy over other groups perceived to be of secondary status. For a very long time, TVET occupied this secondary role when compared to other fields. However, Rust maintained that from the postmodernist perspective, this kind of differentiation is obsolete (p. 618), and that education systems must be modified to accord previously suppressed groups more equitable rights and recognition.

The postmodernist perspective can also be applied to society. According to Slattery (2013), society has become a global plurality with competing subcultures, so that no single belief dominates. People have become more sceptical and discriminating, and there is no acceptance of definite truth, but recognition that the world is a constructed entity where knowledge is contested and incomplete. There is no cultural consensus about what should be the ideal culture, as people can have multiple preferences that are not transfixed, but changeable. Quite often there is little consensus, and curriculum planners for TVET need to adopt new approaches to curriculum development, which will complement the complex social and cultural milieu and prepare students to interact in such a paradigm. For example, TVET planners cannot continue to place emphasis solely on technical skills, but must widen their mandate to address other abilities to better meet the expectations of a postmodern society.

Jin and Li (2011) described the postmodern era as being characterized by "difference and pluralism; organic and ecological ideas; open-ended and inherent relation–oriented ideas; creative and practical ideas; uncertainty and humanity; and integrative neo-conservatism and futurism" (p. 25). Workers in the postmodern work environment enjoy high levels of autonomy, and are often empowered to take decisions and to solve problems as they arise in unpredictable environments. This empowerment of workers has reduced the number of hierarchical levels in organizations, so that the average worker is now expected to take decisions and embark on independent actions without awaiting guidance from a superior. This development calls for a radical reform of TVET, to widen its scope and aim at developing decision makers, problem solvers, and action initiators.

The Image of the New Worker for Postmodern Times

Those associated with TVET in the Caribbean have been excluded from mainstream education for many years, and even when TVET was included at the formal level, they were not perceived as equal partners with those in academics. A postmodernist Caribbean is one where TVET programmes, personnel, and graduates can be accepted as being of value to social and national development. This calls for changes in the thinking of the society at large.

It is therefore very important for Caribbean people to recognize that times have changed. We should now appreciate that there is no one correct way towards a goal, and that different approaches can coexist. Technology has improved to the extent where many operations that were once done manually are now performed by machines, so that many present-day workers must be able to engage in more higher-order activities such as evaluating, trouble-shooting, problem identification, and problem solving. People have also become more sensitive to democratic rights, personal freedoms, and worker aspirations, so that workplace issues such as gender equity, lifelong learning opportunities, sexual harassment, and health and safety cannot be ignored.

In order to meet the requirements of this new age, workers in today's world must have command of work-process knowledge, which is an understanding of the overall purpose, operations, and target markets of the organization. This knowledge can help workers to appreciate productivity and ingenuity (Fischer & Boreham, 2008), and contribute to the development and exploitation of knowledge. All of these developments in a postmodern Caribbean environment mean that there must be a different kind of worker to function in the new work environment, hence there must be wider curriculum reforms and more effective training methods.

The worker in the new age must be well-educated; an independent decision maker, yet a team player; a critical thinker who can get his or her points across in meetings; an entrepreneur who can spot opportunities to monetize his or her skills and abilities; one who understands the scientific principles that underlie work processes; and one who understands how jobs are created and how jobs are lost. We will now consider some of the changes required for TVET to be more relevant to a more demanding and critical Caribbean society.

The Need for Academic Foundations

For many years, onlookers at TVET have perpetuated a belief that students who were unsuccessful in academics could be successful in TVET. For example, Kowlessar (2011) reported that, in an interview, the President of Trinidad & Tobago's National Parent Teachers Association, Zena Ramatali, said, "There are many children who are not academically inclined and focus must be placed on harnessing skills other than academics." Huie (2013) interviewed the Chairman of the TVET Council in St. Kitts and Nevis, Clyde Christopher, who lamented that the message in that country is that TVET is for low achievers, "if you can't read and write 'mek sure you go learn a skill."

But the question must be: Can any worker be skilful, innovative, productive, and resourceful without a relevant foundation in academics? The academics can be regarded as recorded human knowledge. For example, the academics include mathematical and scientific principles already discovered, as well as historical developments, technological developments, properties of materials, and principles of human behaviour. In addition, we must recognize that more and more knowledge is being created with every passing day. If we neglect the academics, we might have to experiment and use trial and error to find out what has already been discovered and recorded. It is therefore critical for TVET students to be capable of applying principles from the academics in the performance of their work. For example, a welder should be able to enlist scientific principles to reduce distortion in fabrications and to prevent embrittlement of welds that can cause fractures. Workers in today's work environment must have a good understanding of academics in order to apply these principles in the performance of their work. There is very little room in the new work environment for those who cannot apply academic principles in working and living.

Vaz (2012), in his keynote address at an international conference on integrating academic courses with vocational education, noted that research has found that the old model of developing students with narrow vocational specializations did little to empower students for meeting the challenges of the present world. McLean and Lai (2011) advised that a technological foundation should be enriched with a broad-based curriculum using a cross-curricular approach to introduce common themes in as many areas as possible, instead of early specialization. Vaz argued that work life cannot be easily isolated from social life, and that TVET needs to prepare the individual for work as well as for gaining fulfilment in life.

Preparation of vocational students to meet these wide-ranging needs means that students will have to acquire knowledge, skills, and dispositions that have been traditionally associated with academic subjects as part of their range of employability skills. Vaz (2012) pointed out that industry requires workers who possess skills that transcend technical skills, such as what he referred to as employability skills required for progressing in an occupation. To be employable, workers must be self-directed, reliable, ethical, good at communicating, willing to work and learn, and possess positive personal attitudes. Vaz argued that present-day workers need interpersonal skills, customer service skills, negotiation skills, resourcefulness, flexibility, motivation, and time management skills. Vaz also noted that the United Kingdom's (UK) NCVQ core skills for employability include numeracy skills, problem solving, information technology skills, and modern foreign language skills (p. xvi).

In this new, era workers should develop an appreciation for diversity, particularly because of globalization. There should be an expectation that everyone should be able to contribute to the development of their society by being informed contributors to democratic processes. Workers constitute an important part of society and their views are also important, so that all workers should have an academic foundation in a broad range of subjects in order to prepare them for contributing to, or critiquing, national and societal decision making. It is therefore imperative that TVET students should have academic knowledge in areas such as history, literature, communication, economics, and environmental science, among other subjects.

In addition, workers must be able to function well in a digital environment, with the ability to use common computer applications for performing tasks, creating solutions, and keeping up to date. McLean and Lai (2011) advised that the education and training of knowledge workers suggests that the trend toward integration should continue to combine academics and technical studies, because the acquisition of technological concepts requires a sound foundation in mathematics, science, and communication skills.

There has been a widely held view that some young people are "not academically inclined," suggesting that this deficit is permanent and irreversible. Worse yet, there are leaders who suggest that people who are not academically inclined should be placed in TVET programmes. For example, in the 2004 Senate debate on the Budget Appropriations Bill in Trinidad and Tobago, Senator Magna Williams-Smith said, "we have established the Multi-Sector Skills Training Programme in July 2004, to address training for employment in the construction industry for about 10,000 persons, especially those who are financially and academically challenged or vulnerable" (p. 481). It must be asked to what extent can someone who is academically challenged function effectively in the construction industry, where accuracy and quality are important performance criteria.

Research by Bloom (1978) found that anyone (except the brain-damaged) can learn what is taught if the subject is taught properly. We need to recognize that top-down teaching is ineffective, and academic programmes should make more use of constructivist methods, where there is active engagement on authentic tasks, reflection, exploration from multiple perspectives, and social negotiation. Lack of academic competence cannot be taken as irreversible among some students, because quite often those students were not properly taught. Improving the teaching methods used in the academic subjects can be effective in reducing the number of students who are labelled as *not academically inclined*.

New Sensitivities to Democratic Rights and Freedoms

In bygone days, the workplace focused on production, and workers were considered to be little more than human machines. Within recent times it has been recognized that satisfied workers are more productive (Sheehan & Griffiths, 2011). Consequently, attention has been given to meeting the personal needs of workers, and giving consideration to their aspirations and democratic rights. In so doing, several issues have gained prominence, and we will now examine some of these developments.

Increasing attention has been given to the protection of workers against sexual harassment and bullying in the workplace, and it is important in preparing workers that they learn to respect the rights of others and give consideration to all. The U.S. Supreme Court has recognized that sexual harassment occurs when unwelcome sexual advances are made on the job to interfere with a person's job or create an intimidating or offensive work atmosphere (Justia, 2013). Although both males and females are subject to sexual harassment, Uggen and Blackstone (2004) found that women appear to be targeted more often, and that they encounter a more virulent form of sexual harassment than men.

Sheehan and Griffiths (2011) made the point that a safe and healthy workplace is one in which the workers' physical and mental well-being are secured; consequently, there must be procedures for addressing bullying in the workplace. Programmes for worker preparation should address this need by taking action to prepare workers who can shape a work culture that rejects sexual harassment and bullying.

Lifelong Education

Because of rapidly changing technologies, materials, and processes, workers must develop a positive disposition to lifelong education and retraining activities. Majumdar (2011) observed that lifelong learning requires learning, re-learning, skilling, and acquisition of new knowledge. It may involve school activities, work-based learning, and other forms of formal and informal learning experiences. Students must recognize the need for lifelong learning and the curriculum must include *learning to learn* experiences, where students can analyse how they learn to facilitate lifelong learning.

King (2011) identified *learning to learn* as being at the core of lifelong learning. He suggested that education and training systems should address lifelong learning by motivating students to learn, helping them learn to learn, and influencing them to reflect on their learning to identify how they learn best. He added that a most important contributor to the development of lifelong learning is to have teachers who naturally expect their students to excel, and thereby inspire them to achieve. Consequently, the recruitment of TVET teachers must not only consider the applicants' technical competence, but should also seek to determine the level of commitment demonstrated by potential teachers.

Health and Safety

Sheehan and Griffiths (2011) explained that Workplace Health Promotion is the combined efforts of employers, employees, and society to improve the health and well-being of people at work. In the past, safety and health issues were treated from the perspective of protecting the individual worker. Nowadays, there are regulations and standards that focus not only on the individual worker, but also on the entire organization and the public as well. Workers should be aware of environmental risks and the need to support sustainable development strategies. They also need to understand the importance of these stipulations and should be motivated to conform.

Quality Focus

There were times when the producers' responsibilities ended after a product was sold or a service was provided. However, there are now national agencies that are mandated to ensure that quality standards are maintained, and TVET management personnel must now ensure that workers are aware of quality standards and are committed to maintain such standards. Anderson, Fornell, and Rust (1997) pointed out that there is a link between customer satisfaction and productivity, because when customers are satisfied with quality products there will be less expenditure in money, time, and effort in handling returns, re-doing work, meeting warranty claims, and addressing customer complaints. TVET programmes must ensure that there are learning objectives which focus on developing quality consciousness among students.

Entrepreneurship

The Indus Entrepreneurs (2003) pointed out that there is a need for people who can identify opportunities for meeting public demand for goods and services by the creation of enterprises, while at the same time producing wealth and jobs. TVET students are trained to develop skills that can help them to earn a living as employees. However, training should not be based on an assumption that TVET graduates are being prepared solely for paid employment by an employer. The possession of TVET skills can be exploited by adequately prepared workers to facilitate their entry into self-employment and to create small enterprises. Furthermore, self-employment and small business creation have become more pressing as tenured employment has been greatly reduced, because large firms outsource operations to smaller firms and individuals. Kalleberg (2012) found that outsourcing has been part of cost-cutting strategies adopted to meet the pressures of globalization, where the main objective is no longer to provide full employment but to maintain price stability. Skilled workers can respond to loss of tenured positions by going into business themselves to benefit from outsourced opportunities.

Lochan (2004) advised that, quite often, attempts at developing entrepreneurial skills are unsuccessful because the course designers have failed to recognize that attitudinal change is required. He noted that the aim should be on development of a spirit of entrepreneurship. Erkkila (2000) outlined several approaches used to develop a spirit of entrepreneurship, including: raising awareness of the role of small business in market economies; participating in authentic business operations, such as involvement in the operation of the school cafeteria and copy centre; and instruction in some of the functional areas of business, such as accounting, finance, marketing, legal issues, business, planning, and management.

The Need for Higher-Order Thinking Skills Among Workers

Workers of today are expected to operate at a level that is higher than simply performing manual operations; they have to take decisions, identify and solve problems, and evaluate solutions. They therefore have to develop higher-order thinking skills that will enable them to engage in critical thinking, researching, and creating solutions. Kerka (1992) explained that learning does not automatically transfer to new settings, but requires carefully designed learning activities. Passive learning does not develop thinking skills, and behaviour change is not always an indicator of higher-order learning. The latter involves the construction of meaning from experience. There is therefore need for more constructivist teaching strategies, alternative assessment methods, and new ways of teacher preparation to support the development of these higher-order skills.

In agreement with Kerka, Lum (2003) explained that a worker's capabilities cannot be determined by any outward manifestation of skills and techniques, because being capable means that the worker possesses wider general and fundamental understandings that facilitate the performance required to complete a job. Some of the components of vocational capabilities include: "having a sense of responsibility, a capacity for decision-making, problem solving, judgement, imagination, leadership; which are neither a matter of knowing facts nor of doing particular things" (p. 3). In order to develop these capabilities Lum (2003) advised that teachers should lead TVET students into consideration of the substantial ends of the task by a process of reflection, visualization, and inference; following which the teacher introspectively determines the nature of understandings required. Afterwards, the teacher selects the most appropriate methods to develop these understandings among the students.

Winch (2013) provides additional support to this view by contending that an essential feature of human action, such as in work performance, is to formulate and execute a plan. He advised that occupational capacity transcends performance of first-order techniques, such as repetitive operations, and includes a combination of second-order abilities related to transversal skills and project management. Transversal abilities include planning, communicating, and evaluating, all of which are critical to work performance. Project management involves long-term sequences of actions that integrate the transversal activities. TVET curricula need to include strategies for developing transversal and project management abilities among students.

Thomas (1992) drew on cognitive theories to recommend that vocational teaching and learning must introduce collaborative learning environments in which groups of students work on authentic tasks. She suggested that classroom activities should be linked to real-world tasks and issues, and should engage students in actively questioning arguments and in applying what was learned to new and novel situations. Furthermore, students should be free to explore alternative ideas, and not accept a single position as being the sole means to a solution. One approach for ensuring that TVET students have experience in working with groups on authentic tasks is to introduce a training model that integrates work-based experiences into vocational TVET.

The European Commission (2013) described three models of combining institution-based with work-based learning. One model, called the *alternance* or *apprenticeship model*, is where the student is based in a workplace and attends an institution to develop occupationally related knowledge. A second model is school-based, where students are enrolled in an institution, but acquire authentic work experiences through temporary attachments or internships. A third model requires the establishment of simulated work environments in the school, and/or the involvement of students in authentic work conducted at the institution, such as in the cafeteria, library, or registry. In addition, there are some schools that undertake live jobs from real clients to provide students with genuine work experiences related to the curriculum These models are worthy of consideration by TVET organizations in the Caribbean if the quality of TVET is to be improved.

Middleton (2003) advised that problem-solving ability can be developed among TVET students by building on the students' existing abilities, and moving to more complex problem-solving tasks. A range of such problems should be drawn from authentic work situations that practitioners could be expected to encounter in the workplace. He noted that problem solving should be complemented by engaging students in problem finding so that they learn to represent problems in various ways. In addition, it should be recognized that problem solving is often a shared activity and that problem-solving tasks should be performed by collaborative groups.

Meeting the Needs of the Digital Age

Bartel and Sicherman (1998) observed that technological change is always accompanied by new work practices. Information and communication technologies (ICTs) have revolutionized the workplace of today, to the extent that the traditional regard for the boundaries of time, location, and organization has lost its significance. Work teams may now comprise members who are based in different and remote locations across the world. Birchall and Giambona (2008) contend that email has become a substitute for face-to-face meetings, and web-based conferencing can take place among participants who are in different locations, so that workers today can work on international projects from their home base.

In addition, Graham (2006) found that new production systems have evolved; one of which is just-in-time production, in which production responds to actual orders, reducing the need to maintain excess inventory. Working in this type of environment requires that workers can access the requisite just-in-time knowledge at the right time. In a digital environment, workers must be able to find the required information in sophisticated document management systems. Furthermore, Wallace (2004) found that workers are now encouraged to build learning communities, to pursue knowledge in areas of common interest, to teach one another, and to share their knowledge. Reforms in TVET to meet present-day needs cannot ignore these imperatives brought about by ICT.

Beven (2003) maintained that digital technology requires workers who are adept at using ICT tools to locate information. He added, however, that workers must also be able to examine information to establish whether the information is related to their needs, and whether the source is credible and reliable. Therefore, apart from being able to use ICT-based communication tools, workers should be able to critically evaluate the information they intend to use. These issues have important implications for the preparation of workers for an ICT-based work environment.

Preparing Workers for Sustaining a Knowledge Economy

The notion of work has expanded from merely meeting needs for goods and services to actually building an economy. The issues considered above, where workers share their knowledge, bring into focus the importance of the knowledge created by workers to the improvement of the general economy. Schultze (2000) advised that knowledge work is the production and reproduction of information. This comprises tacit knowledge, which workers are often unaware that they possess, so that the challenge knowledge workers face is to discover their tacit knowledge and convert it into transmittable information.

At the present time, an increasing number of workers are involved in work that involves the creation of knowledge for economic purposes, so as to build a knowledge economy. Powell and Snellman (2004) pointed out that the growth of economies in developed countries has often been based on the production and dissemination of knowledge. They add that the knowledge economy involves production and services based on knowledge-intensive activities that contribute to technological development. However, they were quick to add that these creations are very often short-lived, and quickly become obsolete, so that there must be ongoing research and knowledge-creation activities. They point out that whereas in the past workers have been expected to contribute mainly physical inputs, today's knowledge workers rely on their intelligence and contribute their ideas. The Caribbean states need to support the development of a knowledge economy by widening their engagement in regional research.

Mustapha and Abdullah (2004) reviewed the literature on knowledge workers and identified several characteristics that employers believe knowledge workers should possess in order to perform their role successfully. They found that workers for the knowledge economy should possess communication and persuasion skills—the ability to influence others to their point of view. Knowledge workers should have an understanding of the fast-changing external environment that will help them to become more flexible and adaptable, with a commitment to lifelong learning.

Knowledge workers need to possess good interpersonal skills so that they can work in teams, willingly giving and receiving suggestions from team members. Additionally, they should be highly tolerant of ambiguity, possess a well-developed sense of personal responsibility, and should not hesitate to take action, once the appropriate indicators for action are present. Furthermore, they must have an entrepreneurial spirit where they can spot and exploit opportunities for using information for wealth creation.

McLean and Lai (2011) observed that the preparation of knowledge workers requires teachers who can facilitate learning rather than merely delivering information. Curricula must promote and facilitate learning and thinking, based on students' performance of learning tasks. They noted that some writers suggested that a competency-based approach to curriculum development could facilitate this change.

Conclusion

In the past, the Caribbean region had a reputation for creativity and self-reliance, and our workers had an international reputation for innovation and competence. This creative capacity has declined because of the ease of acquiring imports, and also because of stagnation in TVET systems that continue to aim at practical skill development at the expense of the development of higher-order skills. Within recent times we have witnessed the widespread importation of foreign workers, while our own people are employed on make-work projects. We have continued in a traditional belief mode where TVET occupies a secondary role in education systems.

However, in order for TVET to regain its relevance to Caribbean development, there is need for curriculum planners to recognize that societies have changed to become more demanding and sceptical. In some respects, this paper is a wake-up call to TVET planners to recognize the changes in the wider society and to respond accordingly. The work norms have changed so that secured tenure in paid positions is on the decline, and the roughness and toughness of the workplace have yielded to new sensitivities to democratic rights and recognition of individual aspirations. To these ends, TVET curricula must be substantially reviewed to focus on achieving the image of a new type of worker for this new age, in which the societal values and expectations are being drastically changed.

Some of the reforms discussed in this paper include focussing on the development of higher-order skills, empowering future workers to be autonomous decision makers, and recognizing students' needs and aspirations through initiatives for their personal development. To achieve these ends, a case was made for greater integration of the academics with worker preparation and the deliberate development of employability skills. The rapid infusion of ICT into all occupations was noted, and planners were warned that this development calls for immediate curriculum revision. Planners were also alerted to the decline of tenured work, and a suggestion was made for TVET programmes to prepare students to exploit their TVET abilities for self-employment and entry into small businesses.

It was posited that in order to facilitate these changes, the model of TVET must be revised to produce a composite model, where TVET would include institution-based preparation combined with work-based experiences in authentic settings. The time has come for TVET in the Caribbean to take a great leap forward; to recognize that past approaches based on specific techniques have become outmoded and inappropriate for the new social and economic environments in the Caribbean.

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CHOICE AND PERFORMANCE IN CSEC AND CAPE TVET SUBJECTS: A Comparison With More Conventional Subjects

Stafford A. Griffith

The study was undertaken to ascertain the extent to which students in their last years of schooling in the Caribbean were opting to pursue technical vocational education and training (TVET) courses of study and examinations, compared with more traditional academic offerings, and whether it was the poor-performing students who were taking TVET courses of study and examinations. The research utilized examinations data from the total population of students in the 16 member countries of the Caribbean Examinations Council (CXC) over a five-year period. The study found that a rather small number of students were opting to pursue TVET courses of study, compared with the number opting to pursue more traditional subjects, such as the natural sciences. The study posited that the small number entering for TVET subjects might well be a consequence of the lack of a large enough range of TVET offerings in schools, the continuing low status accorded to TVET subjects in the employment sector, and the perception that much of the emphasis of the CXC programmes is on providing the theoretical foundations for further education and training rather than on providing employable skills. The findings of the study did not support the view that it is the poor-performing students who are pursuing TVET courses of study and examinations.

Introduction

Currently, the term *technical vocational education and training* (TVET) is popularly used to refer to any subset of experiences that provides occupationally related knowledge and skills to participants (Netherlands Organization for International Cooperation in Higher Education (NICHE), 2010; Unesco, 2001; Unesco, 2010, p. 5). The Caribbean Examinations Council (CXC), which is well known for its role in standard setting and examinations in the Caribbean (Griffith, 2008), provides a limited number of secondary and post-secondary subjects that qualify as TVET offerings. Under the Caribbean Secondary Education Certificate (CSEC), it offers four Technical Proficiency subjects

(Building Technology – Construction; Building Technology – Woods; Electrical and Electronic Technology; and Mechanical Engineering Technology) and one General Proficiency subject (Technical Drawing). The Technical Proficiency offerings of CXC were conceived as an end-of-secondary-school examination with more practical orientation than the General Proficiency scheme and the now discontinued Basic Proficiency scheme (CXC, 1991; Griffith, 1999). Each of these subjects requires two years of preparation, normally in the last two years of the secondary education programme.

Students completing the CSEC TVET subjects are able to proceed to post-secondary studies in related areas offered under the CXC Caribbean Advanced Proficiency Examination (CAPE). CAPE offerings are defined in terms of subject Units, each of which would normally require one year of post-secondary preparation leading to an examination. Where a subject consists of two Units, a student may, in most instances, opt to take Unit 1 or Unit 2 in the first year and proceed to the second Unit in the next year or at a later date. The CAPE TVET offerings include Electrical and Electronic Technology Units 1 and 2, and Geometrical and Mechanical Engineering Drawing Units 1 and 2.

Perspectives of TVET in the Education System

TVET has had lukewarm support in the Caribbean. This is due, in part, to its heritage, grounded in the British education system with all the colonial prejudices that accompanied its introduction. Sanderson (1993) puts forward a number of reasons why, historically, non-vocational or liberal education has had more prestige than vocational training in Britain. One of these is that the UK universities in the 19th century were best classified by three main traditions in liberal education: the study of classics at Oxford, mathematics at Cambridge, and philosophy in the Scottish universities. These subjects were pursued because of the belief in their capacity "to train the mind and cultivate the intellect rather than for the usefulness of the content" (Bagnall, 2000, p. 462). Another consideration cited by Sanderson was that, compared to vocational education, non-vocational or liberal education was not expensive. The overheads were low, and the classics that comprised much of the foundation for that education could be reproduced and made accessible to students at low cost.

It is this educational focus that was transferred to the colonies and, as was the practice with colonial endowment in the early years, came to be much valued in establishing social standing, gaining social mobility, and obtaining privileged employment. This perspective of education was the centrepiece for the model of early colonial education in Caribbean countries and contributed to the perception of TVET as second-class education, fit only for low achievers.

Didacus Jules, Registrar and Chief Executive Officer of CXC, provides an apt summation of the perspective on TVET in the region. According to Jules (2011):

> TVET has not taken root in Caribbean education systems because notwithstanding the discourse, it is still treated by planners and seen by the public as a compensatory device. It is seen as something that is to be provided to students who – in the words most frequently used – are not "academically minded". Thus it is consequently relegated to second class status; providing a compensatory alternative that will supposedly guarantee some skilled work for this category of student. (p. 6)

The experience in Jamaica, the most populous of the English-speaking Caribbean countries and a significant member country of CXC, is illustrative of what transpired in the Caribbean. Despite the inclusion of TVET as an important dimension of the education thrust of Jamaica in the early 1970s, the students who were sent to the schools where such programmes were implemented, that is, the Junior High, New Secondary, or Comprehensive High schools, were drawn from among those who performed at the lower levels at the end of primary school examinations (Petgrave, 2011). TVET programmes were less a feature in the Traditional High schools than in those schools. This view of TVET as an area of study for low-performing students predominates in Caribbean countries.

Referring to prevailing circumstances in Jamaica, Griffith (2011) pleaded for proper recognition to be given to the skills which secondary school graduates acquire through the study of subjects that provide them with employable skills, including TVET subjects. Griffith was of the view that while government policies may be calling for more secondary school graduates with employable skills, little value is placed on such qualifications, as evidenced in public discussions.

There is some indication that the tide of negativity about TVET is gradually turning. A number of studies have debunked the myth of TVET as an area of study for poor-performing students destined for manual occupations. The research evidence shows that an increasing number of students with TVET concentrations are enrolling in post-secondary education (Levesque, Lauren, Teitelbaum, Alt, & Librera, 2000; Ko, 2005). There is also some evidence in the United States that TVET graduates are enrolling in the more competitive four-year college programmes rather than the shorter two-year programmes. This was certainly the case in the state of Missouri, where Ko (2005) found that 53% of graduates from TVET schools tend to enrol in four-year college programmes, compared with 47% who enrol in two-year programmes. Awareness of these developments is contributing to the shifting of views about TVET as an area of study for poor-performing students.

Increasing awareness and ventilation of models that seek to mainstream TVET is contributing, further, to a less negative view of TVET. In a research article comparing vocational secondary and general secondary schooling in France and Australia, Bagnall (2000) lauded the French model that increased the options open to students studying at the post-compulsory years of schooling, by offering the *Bac Pro* as a genuine vocational qualification that does not restrict later movements of students into higher education. According to Bagnall, by doing so, the French had effected a double play: “Those who wish to begin work immediately have a qualification that allows for a transition directly into the workforce. Those who do not may continue on with a higher education course of study” (Bagnall, 2000, p. 472).

Bagnall (2000) concluded that it is necessary for education provisions to move away from stereotypes that have evolved over centuries. He argued that we can no longer give status and prestige to one system of education, namely, general education, and not another, namely, vocational education. He took the position that such a restriction in the provision of status would be “undermining and irrevocably damaging the future pathways of not only the youth cohort but also the ‘life courses’ of many adults” (Bagnall, 2000, p. 473).

More recently, Griffith (2009) pointed to the need for articulation between post-secondary programmes of TVET institutions and more advanced levels of certification offered at higher education institutions. Griffith, in fact, suggested the need for a systems-wide alignment of TVET programmes so that students are able to move smoothly from secondary school, through the programmes of TVET tertiary institutions, and into programmes of higher education that culminate in advanced technical degrees or similar advanced professional certification. This, in his view, should help to remove any lingering perception that TVET programmes are aimed only at poor-performing students. He expressed the view that if we could give the seriousness of attention to TVET in the Caribbean that the Japanese have long given it (Yamamoto, 1995), we could look forward to attracting more of the best and the brightest to TVET, with the prospect of even more extensive innovations in TVET to accelerate national development.

Similar sentiments were echoed in other recent publications, including that of Dare (2000), where it was argued that "it is imperative to provide both academic and vocational courses that allow student to pursue post secondary education and work without limits to their opportunities" (p. 322), and that of Kotamraju (2007), who made a related plea for increased secondary and post-secondary collaboration in career and technical education programmes, without which a smooth transition of secondary school students to college would not be accomplished. It would be useful to explore whether the developments and sentiments reflected more recently about TVET are reflected in a change in practice among students in the Caribbean with respect to choice of courses of study.

Purpose of the Study

The study sought to ascertain the extent to which students in their last years of schooling in the Caribbean were opting to pursue TVET courses of study and examinations, compared with more traditional academic offerings, and whether it is the poor-performing students who take these courses of study and examinations, compared with the type of students who take courses and examinations in the more academic subjects.

Research Questions

Two research questions guided the investigation:

1. *To what extent does the number and proportion of students taking TVET subjects at the CSEC and CAPE levels differ from those taking more traditional subjects?*
2. *To what extent does the proportion of students taking TVET subjects at the CSEC and CAPE levels who obtain acceptable grades differ from those taking more traditional subjects?*

These two research questions were explored to ascertain (a) the extent to which students were choosing to do TVET subjects, and (b) the quality of performance of students in these subjects.

Definition of Terms

For this study, the industrial technology offerings at the CSEC and CAPE levels were used to represent the TVET subjects. These were the core TVET subjects offered by CXC at these two levels. The subject offerings in the natural sciences at the CSEC and CAPE levels were used to represent the more traditional subjects. These were subjects on which high value has been placed, traditionally, in the region.

Data for the Study

The TVET Subjects

All five CSEC TVET subjects offered by CXC were included in the study. These were:

- Building Technology – Construction (BldT-C)
- Building Technology – Woods (BldT-W)
- Electrical and Electronic Technology (ElecT)
- Mechanical Engineering Technology (MechE)
- Technical Drawing (TD)

The four subject Units from the CAPE offerings, which are linked to the Industrial Technology syllabus offerings at the CSEC level, were included in the study. These were:

- Electrical and Electronic Technology Unit 1: Electrical Theory and Communications (ElecT-1)
- Electrical and Electronic Technology Unit 2: Energy Converters and Logic Circuits (ElecT-2)
- Geometrical and Mechanical Engineering Drawing, Unit 1: Geometrical and Engineering Drawing (GMED-1)
- Geometrical and Mechanical Engineering Drawing, Unit 2: Mechanical Engineering Drawing and Design (GMED-2)

The More Traditional Subjects

As noted earlier, the more traditional subjects will be represented by the subjects in the natural sciences, commonly referred to as Science subjects. These Science subjects were selected because they form critical offerings in the traditional secondary education programme at the more prestigious schools in the Caribbean, and because they are generally regarded as subjects that high-performing students are likely to pursue. They should, therefore, serve as a good basis for comparison with the TVET subjects that have traditionally occupied the lower end of the value spectrum.

For CSEC, these subjects were:

- Biology (Bio)

- Chemistry (Chem)
- Physics (Phys)

The related subjects at the CAPE level were:

- Biology – Unit 1: Biomolecules, Reproduction and Development (Bio-1)
- Biology – Unit 2: Bioenergetics, Biosystems and Applications (Bio-2)
- Chemistry – Unit 1: Chemical Principles and Applications I (Chem-1)
- Chemistry – Unit 2: Chemical Principles and Applications II (Chem-2)
- Physics – Unit 1: Mechanics, Waves and Properties of Matter (Phys-1)
- Physics – Unit 2: Electricity and Magnetism, A.C. Theory and Electronics, and Atomic and Nuclear Physics (Phys-2)

Candidates

The total population of candidates who took the selected CSEC and CAPE TVET and Science subjects in the 16 CXC member countries over the five-year period 2007–2011 were included in the study. The aggregated candidate entries across the 16 CXC member countries for each of the five years were extracted from a soft copy of CXC's *Statistical Bulletin 2011*. The grades obtained by candidates in each of the selected TVET and Science subjects were also extracted from the *Bulletin.* For the CSEC subjects, Grades I to III are regarded as acceptable grades, while for CAPE subjects, Grades I to V are regarded as acceptable. The candidate entries and the grades obtained by candidates formed the primary sources of data for the study.

Procedures

The data in the CXC *Statistical Bulletin 2011* is a database that the Council provided to its member countries. It contains, inter alia, subject entries and results for the current and past years. With the use of Excel Pivot Tables, the reports required for the study were generated and exported into Microsoft Word, where the refined titles, and column and row labels were inserted. The reports generated through the use of Excel Pivot Tables were used to generate graphs that summarized the findings and helped to enhance data analysis.

Findings

Number and Proportion of Students Taking TVET and Science Subjects at the CSEC and CAPE Levels

The first research question was concerned with the number and proportion of students in the region who take TVET subjects at the CSEC and CAPE levels, compared with those who take Science subjects. The findings are presented, first, for the CSEC subjects and, subsequently, for the CAPE subjects.

CSEC subjects

Table 1 presents a comparison of the number and percentage of candidates who took CSEC TVET subjects and those who took CSEC Science subjects in CXC member countries. The table shows that, for the five CSEC TVET subjects, there was a total of 93,892 candidate entries over the five-year period, giving a mean of 18,778 entries annually. For the three CSEC Science subjects, candidate entries totalled 213,254 over the same period, giving a mean of 42,651 annually.

It is evident that the number of candidate entries for the CSEC TVET subjects was much smaller than the number of candidate entries for the CSEC Science subjects. Based on the data for the five CSEC TVET subjects in the study, the mean subject entry annually was 3,756, compared with the mean subject entry of 14,217 annually for the three CSEC Science subjects. More students were evidently entering for CSEC Science subjects than for CSEC TVET subjects—nearly 4 times (3.79) the mean number per subject entering TVET. None of the TVET subjects in any of the five years had entries comparable to the Science subjects; not even the ones with the lowest entries.

Table 1 shows that the annual CSEC TVET subject entries, as a percentage of the total candidate entries for the examinations at that level, ranged from 2.88 to 3.03% over the five-year period, with an annual mean of 2.98%, while the CSEC Science subject entries ranged from 6.49 to 7.29%, with an annual mean of 6.73%.

The range for the annual percentage of subject entries for CSEC TVET subjects over the five-year period was very small; no more than .15. These percentages were lowest in the last two years, that is, 2010 and 2011. The range of .80 for the annual percentage of subject entries for CSEC Science subjects over the five-year period, though small, was much larger than that for the CSEC TVET subjects (more than 5 times larger). Also, for the CSEC Science subjects, the annual percentage of subject entries was highest in the last two years, compared with the CSEC TVET subjects where they were the lowest in those two years.

Table 1. Comparison of Number and Percentage of Candidate Entries for CSEC TVET and Science Subjects

TVET Subjects	2007		2008		2009		2010		2011		Overall	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**Total**	**Mean**
BldT-C	1,469	0.25	1,554	0.26	1,707	0.28	1,919	0.28	2,101	0.31	8,750	1,750
BldT-W	2,140	0.37	2,284	0.38	2,232	0.36	2,361	0.35	2,581	0.38	11,598	2,319
ElecT	3,806	0.65	3,644	0.60	3,800	0.62	3,893	0.57	3,912	0.58	19,055	3,811
MechE	1,849	0.32	1,786	0.30	2,033	0.33	2,205	0.32	2,047	0.30	9,920	1,984
TD	8,467	1.45	8,792	1.46	8,774	1.43	9,316	1.36	9,220	1.37	44,569	8,914
Total	**17,731**	**3.03**	**18,060**	**2.99**	**18,546**	**3.02**	**19,694**	**2.88**	**19,861**	**2.96**	**93,892**	**18,778**
Science Subjects Bio	14,779	2.52	15,048	2.45	15,048	2.45	17,510	2.56	18,151	2.70	80,536	16,107
Chem	12,159	2.08	12,475	2.07	12,902	2.10	14,344	2.10	16,236	2.42	68,116	13,623
Phys	11,620	1.98	11,895	1.97	12,479	2.03	14,086	2.06	14,522	2.16	64,602	12,921
Total	**38,558**	**6.58**	**39,418**	**6.49**	**40,429**	**6.58**	**45,940**	**6.72**	**48,909**	**7.29**	**213,254**	**42,651**

CAPE subjects

Table 2 presents a comparison of the number and percentage of candidates who took CAPE TVET subjects and those who took CAPE Science subjects in CXC member countries. The table shows that, for the four CAPE TVET subjects, there was a total of 4,590 candidate entries over the five-year period, giving a mean of 918 entries annually. For the six CAPE Science subjects, candidate entries totalled 89,086 over the same period, giving a mean of 17,817 annually.

As was the case for the CSEC subject entries, the number of candidate entries for the CAPE TVET subjects was much smaller than the number of candidate entries for the CAPE Science subjects. Based on the data for the four CAPE TVET subjects in the study, the mean subject entry annually was 230 compared with the mean subject entry of 2,970 annually for the six CAPE Science subjects. As in the instance of CSEC, more CAPE students were evidently entering for the Science subjects than for TVET subjects. In fact, for CAPE, the mean subject entry in Science was nearly 13 times (12.91) the mean subject entry for the TVET.

Table 2 shows that the annual CAPE TVET subject entries, as a percentage of the total candidate entries for the examinations at that level, ranged from 0.92 to 1.03% over the five-year period, with an annual mean of 0.97%, while the CAPE Science subject entries ranged from 17.63 to 19.91, with an annual mean of 18.78%. As in the case of the CSEC subjects, it is evident that CAPE Science subjects had a larger proportion of subject entries compared with the CAPE TVET subjects.

The range for the annual percentage of subject entries for CAPE TVET subjects over the five-year period was very small, no more than .11. These percentages fluctuated over the five-year period. The range of 2.28 for the annual percentage of subject entries for CAPE Science subjects over the five-year period was much larger than that for the CAPE TVET subjects. In fact, this range was larger than those for all the other groups of subjects in this investigation, that is, CSEC TVET, CSEC Science, and CAPE TVET subjects. As was the case for the CSEC Science subjects, the annual percentage of subject entries was highest in the last two years.

Table 2. Comparison of Number and Percentage of Candidates Entries for CAPE TVET and Science Subjects

TVET Subjects	2007		2008		2009		2010		2011		Overall	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**Total**	**Mean**
ElecT-1	75	0.09	117	0.14	117	0.12	163	0.16	131	0.12	603	121
ElecT-2	62	0.08	26	0.03	92	0.10	60	0.06	76	0.07	316	63
GMED-1	407	0.50	444	0.51	458	0.49	513	0.50	558	0.51	2,380	476
GMED-2	214	0.26	205	0.24	255	0.27	312	0.31	305	0.28	1,291	258
Total	**758**	**0.93**	**792**	**0.92**	**922**	**0.98**	**1,048**	**1.03**	**1,070**	**0.99**	**4,590**	**918**
Science Subjects												
Bio-1	2,702	3.30	3,092	3.58	3,651	3.89	4,261	4.19	4,594	4.24	18,300	3,660
Bio-2	1,740	2.12	2,193	2.54	2,485	2.64	2,798	2.75	3,042	2.81	12,258	2,451
Chem-1	3,778	4.61	3,485	4.03	4,041	4.30	4,812	4.73	4,702	4.34	20,818	4,164
Chem-2	1,784	2.18	2,385	2.76	2,710	2.88	2,961	2.91	3,283	3.03	13,123	2,625
Phys-1	2,753	3.36	2,527	2.92	2,972	3.16	3,181	3.13	3,392	3.13	14,825	2,965
Phys-2	1,685	2.06	1,886	2.18	1,785	1.90	2,229	2.19	2,177	2.01	9,762	1,952
Total	**14,442**	**17.63**	**15,568**	**18.02**	**17,644**	**18.78**	**20,242**	**19.91**	**21,190**	**19.55**	**89,086**	**17,817**

Proportion of Students With Acceptable Grades in TVET and Science Subjects at the CSEC and CAPE Levels

The second research question was concerned with the proportion of students in the region taking TVET subjects at the CSEC and CAPE levels who obtain acceptable grades, compared with those who take Science subjects. The findings are presented, first, for the CSEC subjects and, subsequently, for the CAPE subjects.

CSEC subjects

Table 3 presents a comparison of percentage of candidates who obtained acceptable grades for CSEC TVET subjects and CSEC Science subjects in CXC member countries. As noted earlier, for CSEC, Grades I to III are regarded as acceptable. Table 3 shows that the percentage of candidates who obtained acceptable grades annually in CSEC TVET subjects over the five-year period ranged from 54.89 to 61.36, with an annual mean of 57.09; while the percentage for the CSEC Science subjects ranged from 58.83 to 69.70, with an annual mean of 64.32%. The CSEC Science subjects had a slightly larger proportion of candidates obtaining acceptable grades compared with the CSEC TVET subjects (a difference of 7.23 percentage points in the annual mean percentage obtaining acceptable grades).

Table 3. Percentage of Candidates Obtaining Acceptable Grades for CSEC TVET and Science Subjects

TVET Subjects	**2007**	**2008**	**2009**	**2010**	**2011**
BldT-C	62.15	77.28	67.90	71.29	74.63
BldT-W	56.12	48.69	62.23	68.32	64.66
ElecT	57.28	56.64	42.63	54.30	40.16
MechE	47.21	53.14	50.86	52.97	47.19
TD	58.40	52.85	59.39	62.48	58.03
Overall	**57.03**	**54.89**	**56.15**	**61.36**	**56.01**
Science Subjects					
Bio	67.64	70.43	69.48	64.41	65.83
Chem	58.61	62.37	70.92	62.35	55.33
Phys	47.85	70.44	68.69	63.12	64.06
Overall	**58.83**	**67.88**	**69.70**	**63.37**	**61.82**

The variability in the annual percentage of candidates with acceptable grades was much smaller for CSEC TVET subjects than for CSEC Science subjects. For the former, the range was 6.47 compared with 10.87 for the latter. For both CSEC TVET subjects and CSEC Science subjects, the percentage of candidates who obtained acceptable grades fluctuated across the five years. Both the variability and the fluctuations in the proportion of candidates with acceptable grades for CSEC TVET subjects and CSEC Science subjects across years, and overall, can be easily discerned and compared in Figure 1.

In addition, the graph highlights the fact that the percentage of candidates obtaining acceptable grades in CSEC TVET Building Technology - Construction (BldT-C) far exceeded the percentage of candidates who obtained acceptable grades in the other CSEC TVET subjects in each of the five years, as well as in the CSEC Science subjects for three of the five years. The figure also highlights how comparable the percentage of candidates obtaining acceptable grades was with the percentage obtaining those grades in the CSEC Science subjects.

CAPE subjects

Table 4 presents a comparison of the percentage of candidates who obtained acceptable grades for CAPE TVET subjects and CAPE Science subjects in CXC member countries. As noted earlier, for CAPE, Grades I to V are regarded as acceptable. Table 4 shows that the percentage of candidates who obtained acceptable grades annually in CAPE TVET subjects, overall, over the five-year period ranged from 61.74 to 70.45, with an annual mean of 66.68%; while the percentage for the CAPE Science subjects ranged from 84.93 to 89.36, with a mean of 87.28%. The CAPE Science subjects, therefore, had a much larger proportion of candidates obtaining acceptable grades compared with the CAPE TVET subjects (a difference of 20.60 percentage points in the annual mean percentage obtaining acceptable grades).

The statistics from Tables 1 and 2, taken together, show that, overall, the proportion of candidates who obtained acceptable grades in CAPE TVET subjects was higher than the proportion who obtained acceptable grades in the case of CSEC TVET subjects. The annual mean percentage of candidates, over the five-year period, who obtained acceptable grades in CSEC TVET subjects was 57.09, compared with 66.68 for the CAPE TVET subjects. A similar position was observed for the Science subjects. While the annual mean percentage of candidates, over the five-year period, who obtained acceptable grades in CSEC Science subjects was 64.32%, that for the CAPE Science subjects was 87.28. The larger proportion of candidates obtaining acceptable grades at the CAPE level is in keeping with what might be reasonably expected, given that it is the better performers in CSEC who tend to proceed to do CAPE in the related subjects. It should be noted, though, that there was a wider percentage difference for Science subjects than for TVET subjects.

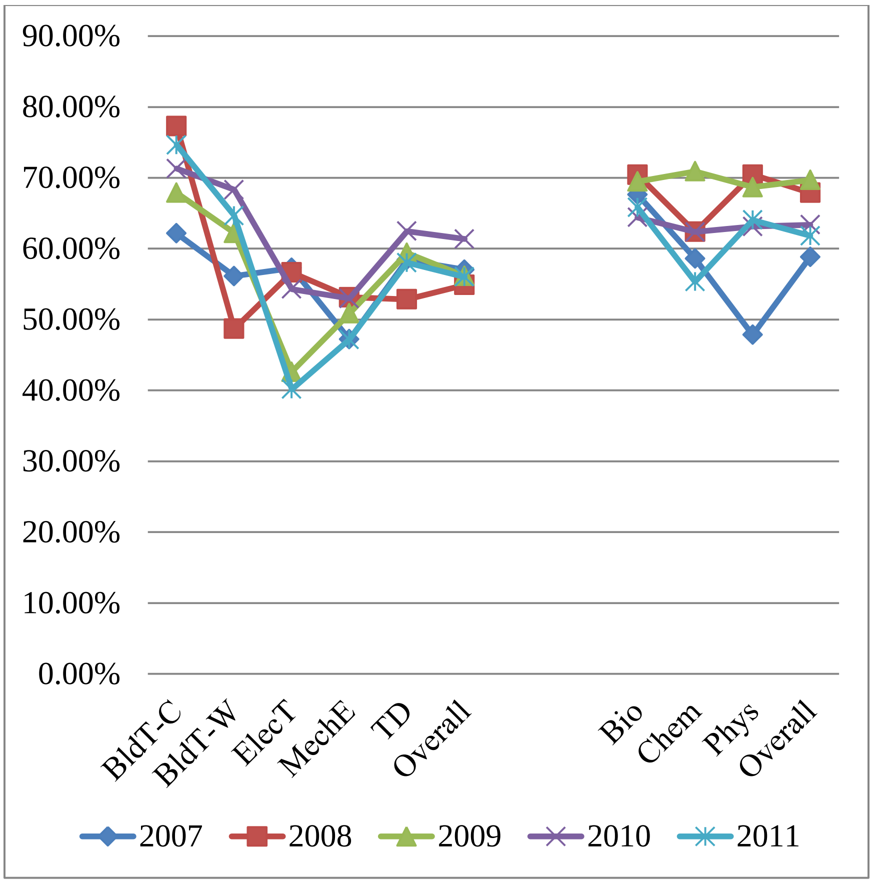

Figure 1. Percentage of CSEC TVET and Science candidates obtaining acceptable grades.

Table 4. Percentage of Candidates Obtaining Acceptable Grades for CAPE TVET and Science Subjects

TVET Subjects	2007	2008	2009	2010	2011
ElecT-1	52.00	59.83	71.79	33.13	51.15
ElecT-2	85.48	80.77	69.57	60.00	68.42
GMED-1	67.57	66.22	60.48	66.28	62.37
GMED-2	78.04	74.63	75.69	69.55	79.34
Overall	**70.45**	**67.93**	**67.03**	**61.74**	**66.26**
Science Subjects					
Bio-1	86.16	87.35	86.14	80.29	75.53
Bio-2	94.71	93.30	94.12	90.39	92.11
Chem-1	87.74	83.47	80.65	80.76	76.73
Chem-2	95.52	91.49	86.64	88.75	86.75
Phys-1	84.74	87.61	82.40	85.57	88.35
Phys-2	93.59	90.19	86.61	89.95	88.06
Overall	**89.36**	**88.34**	**85.50**	**84.93**	**88.26**

Contrary to the findings for the CSEC subjects, there was much less variability across the five years in the proportion of candidates who obtained acceptable grades for CAPE Science subjects than for CAPE TVET subjects. For the CAPE Science subjects, the range in the annual percentage of candidates with acceptable grades was 4.43, while for CAPE TVET subjects it was 8.71. For both CAPE TVET subjects and CAPE Science subjects, the percentage of candidates who obtained acceptable grades fluctuated across the five years. Both the variability and the fluctuations in the proportion of candidates with acceptable grades for CAPE TVET subjects and CAPE Science subjects across years, and overall, can be easily discerned and compared in Figure 2.

The difference in proportion of candidates obtaining acceptable grades in CAPE Science subjects is evident from the graph. The year 2010 seemed to have been a year of particularly poor performance of candidates for most CAPE TVET subjects.

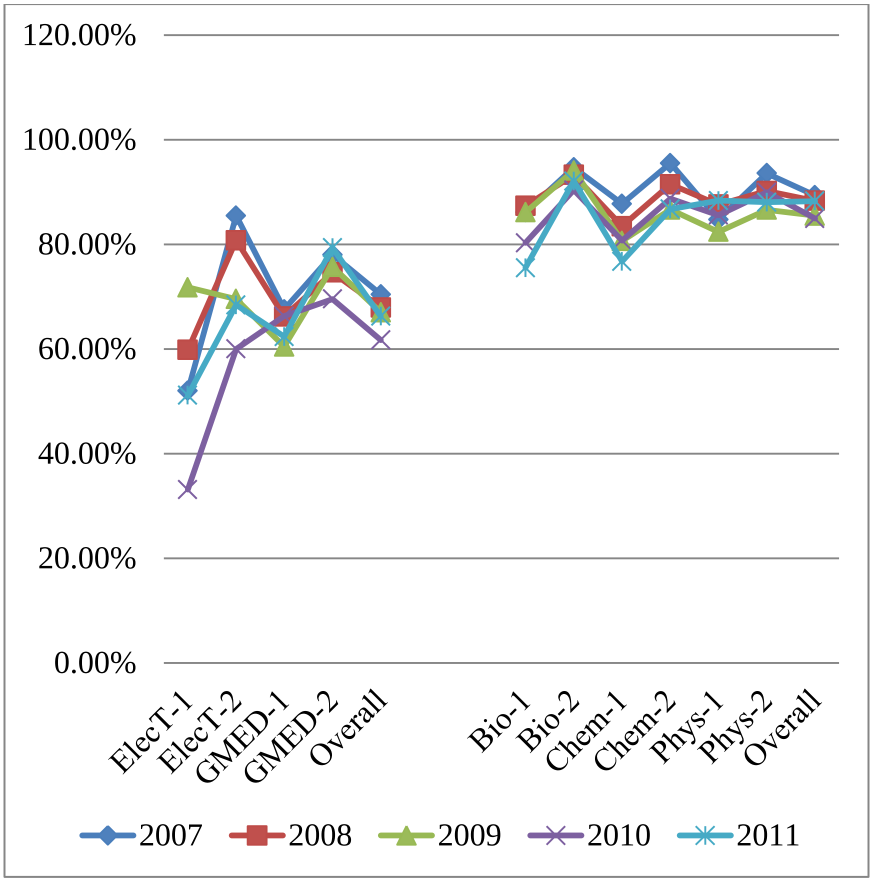

Figure 2. Percentage of CAPE TVET and science candidates obtaining acceptable grades.

Discussion

This study sought to ascertain the extent to which students in their last years of schooling in the Caribbean were opting to pursue TVET courses of study and examinations, compared with more traditional academic offerings, and whether it is the poor-performing students who take these courses of study and examinations, compared with the type of students who take courses and examinations in the more academic subjects. In this study, the Science subjects were used to represent the more traditional subjects. The research utilized examinations data from the CXC database to probe the two related research questions. The total population of students entering for the TVET and Science subjects over a five-year period was used for both CSEC and CAPE.

With respect to the question of the number and proportion of students who pursue TVET subjects, compared with the more traditional Science subjects, it was found that a larger number and proportion of students were registering for both CSEC and CAPE Science subjects than for CSEC and CAPE TVET subjects. The disparity in number and proportion was much greater at the CAPE level than at the CSEC level. Nearly four times the mean number of students per subject registered for CSEC Science subjects than for CSEC TVET subjects. At the higher CAPE level, the mean entry was nearly 13 times greater for Science subjects than for TVET subjects.

The proportion of candidate entries for CSEC TVET subjects in the five years included in this study did not vary much. These remained very small (mean ranging from 2.88 to 3.03%) and, in fact, declined over the last two years covered by this study. The proportion taking CSEC Science subjects varied much more across the five years (mean ranging from 6.49 to 7.29%) and, unlike the case of TVET subjects, increased over the last two years.

There was even less variation in the proportion of candidate entries for CAPE TVET subjects in the five years covered by the study (mean ranging from 0.92 to 1.03%). As in the case of CSEC, the variation in the proportion of entries for the CAPE Science subjects was much larger (mean ranging from 17.63 to 19.91%) than for CAPE TVET subjects.

It may therefore be concluded that the proportion of students entering for CSEC TVET subjects was generally small, stagnated, and declining; while entries for CSEC Science subjects were larger and increasing. With respect to the CAPE level, it may be concluded that the proportion of students entering for TVET subjects was even smaller and equally stagnated, while the proportion of students entering for Science subjects was much larger.

There was a notable decline in candidate entries for both CAPE TVET and Science subjects, compared with entries for CSEC TVET and Science subjects, respectively. This is understandable given the number of students who do not perform satisfactorily enough at the CSEC level to be able to proceed directly to the more advanced CAPE programme. Even when students have performed satisfactorily in the CSEC examinations, their prospect of enrolling in this post-CSEC programme is constrained by the limited number of CAPE places available in schools. Often, only those with the higher grades (invariably Grade 1 only) in the related subjects are able to access these places. Also, some of those who perform satisfactorily pursue other destinations. Many enter the workforce while others pursue further education and training in tertiary institutions.

Despite this understandable decline in the number of entries for both CAPE TVET and Science subjects, compared with entries at the CSEC level, it is evident that at the CAPE level, the Science entries as a proportion of the total CAPE entries in CXC member countries increased notably (from 6.73% at the CSEC level to 18.78% at the CAPE level); while the TVET entries as a proportion of the total CAPE entries decreased sharply (from 2.98% at the CSEC level to 0.97% at the CAPE level). It may be concluded, therefore, that the proportion of the CSEC cohort opting for advanced studies was very small and that students pursuing studies at this level were more likely to pursue the more traditional Science subjects.

These findings highlight the fact that, in the Caribbean, a rather small number of students are opting to pursue TVET courses of study compared with the number opting to pursue more traditional subjects, such as the natural sciences. The small number of students who enter for both CSEC and CAPE TVET subjects might well be a consequence of the lack of a large enough range of TVET offerings in schools to encourage students to take a concentration in TVET, by pursuing a cluster of TVET subjects that is linked to options that they may pursue upon completing their schooling.

The small number opting for TVET subjects might well be related to a low status accorded to those subjects in the employment sector. In pointing to challenges faced by students who pursue CXC TVET offerings, Hamilton Jemmott, a lecturer in Technical and Vocational Studies in the Barbados Community College, made the point that “some of this particular group may achieve the CXC qualification, but the question arises as to what extent they are able to use the qualification for entry into the labour force” (Jemmott, 2011, p. 26). This challenge of using the CXC TVET qualifications to enter the labour force might be due, at least in part, to the perception that much of the emphasis of the CXC programmes is on providing the theoretical foundations for further education and training rather than on providing employable skills.

CXC is currently reviewing its TVET offerings at both the CSEC and CAPE levels. The organization has also initiated the certification of a range of vocational qualifications under a Caribbean Vocational Qualifications (CVQ) framework, with significant private sector involvement. The review of the CSEC and CAPE TVET offerings, coupled with the initiation of the CVQs, might well provide the opportunity to create a sufficiently comprehensive set of TVET offerings, which will allow students to take clusters of TVET subjects that will not merely make them eligible for further education and training but will provide them with valuable employable skills. This should, in turn, assist in raising the status of TVET in the employment sector.

Such an extension of TVET offerings will have cost implications, which must be addressed by CXC and its member countries. Several authors have called attention to the higher cost of TVET programmes, compared to more traditional education programmes (Bagnall, 2000; Sanderson, 1993; Sharma, 1999). However, given the acknowledged benefits of TVET education (Bagnall, 2000; Griffith, 2009; Petgrave, 2011), the financing of such programmes should be a critical policy consideration in assuring the skilled workforce necessary for the region's development.

All students should, at the very least, be encouraged to include some TVET subjects in their courses of study, not only because the majority of students graduating from school are likely to go directly into the workforce, but also because of the value of TVET for other destinations, as pointed out by Silverberg, Warner, Fong, and Goodwin (2004). Based on their research, these authors contend that students should be encouraged to take a balanced mix of subjects. Their findings suggest that when high school students increase the number of academic courses and TVET courses taken simultaneously, they are better prepared for college than those students who focus only on academics.

The issue of whether it is the poor-performing students who pursue TVET courses of study and examinations, compared with the type of students who take courses and examinations in the more academic subjects, was explored through an assessment of the proportion of students taking TVET subjects at the CSEC and CAPE levels who obtain acceptable grades, compared with those taking the more traditional Science subjects.

It was found that, generally, the CSEC Science subjects had only a slightly larger proportion of candidates obtaining acceptable grades, compared with the CSEC TVET subjects (a mean percentage of 57.09 for TVET subjects and 64.32 for Science subjects over the five-year period of the study). However, in one CSEC TVET subject, CSEC TVET Building Technology - Construction (BldT-C), the proportion of students who obtained acceptable grades far exceeded the proportion who obtained acceptable grades in the CSEC Science subjects for three of the five years covered by this study.

At the CAPE level, the difference between the proportion of students with acceptable grades in TVET subjects and Science subjects was much more pronounced (a mean percentage of 87.28 for Science subjects over the five-year period, compared with 64.32 for TVET subjects). There was little variation across the five years of the study in the proportion of candidates who obtained acceptable grades in CSEC TVET (54.89 to 61.36%) and Science subjects (58.83 to 69.70%). A similar observation was made with respect to the CAPE subjects (61.74 to 70.45% for TVET and 84.93 to 89.36% for Science).

A notable observation is that the proportion of students who obtained acceptable grades at the CAPE level was higher in the case of both the TVET subjects and the Science subjects (an annual mean of 57.09% for the CSEC TVET subjects compared with 66.68% for CAPE TVET subjects; and 64.32% for the CSEC Science subjects compared with 87.28% for CAPE Science subjects). This higher proportion of students at the CAPE level with acceptable performance is in keeping with reasonable expectation, given that, as noted earlier, it is the better performers at CSEC who successfully compete for the limited opportunities to proceed to the CAPE programme.

Taking into account that CXC syllabuses and examinations are constructed to assure equivalence of demand among subjects at each of the two levels, the results indicate that, at the CSEC level, there was no marked difference in the performance of students taking TVET subjects and those taking the more traditional Science subjects. At the CAPE level, there was a greater disparity in performance between those who entered for Science subjects and those who entered for TVET subjects, with those in the former category demonstrating better performance than those in the latter. The quality of performance across the years was relatively stable at the CSEC and CAPE levels for both the TVET subjects and the more traditional Science subjects.

From the results of the study, it cannot be concluded that it is the poor-performing students who are pursuing TVET courses of study and examinations, compared with those who take courses and examinations in the more academic subjects. The closely related performance of students who take Science subjects and TVET subjects at the CSEC level does not support such a view. The results for the CAPE subjects require further examination. The achievement of acceptable grades by 67% of TVET students, while markedly different from the 87% of Science students who achieved such grades, is by no means a reflection of poor performance on the part of TVET students. That performance is at least moderately good. The gap is not sufficiently pronounced to come to the conclusion that it is the weaker CAPE students who are taking the TVET subjects.

A further probe of the proportion of CAPE candidates in relation to CSEC candidates over the five-year period of the study revealed that the cumulative CAPE Science entries over the five years represent 41.78% of the CSEC Science entries, while the CAPE TVET entries represent only 4.89% of the CSEC TVET entries. While this phenomenon requires further research, the numbers might well be indicating that those who complete CSEC TVET subjects are pursuing options other than continuing TVET studies at the CAPE level. It is possible that this is the result of limited opportunities to pursue a complete suite of TVET subjects at the higher CAPE level, and the better-performing TVET students may be opting for CAPE programmes that provide them with more comprehensive offerings in certain areas of concentration. In order to have the increased enrolment in TVET subjects in the Caribbean that was noted elsewhere (Levesque et al., 2000; Ko, 2005), it is necessary to increase the suite of offerings in TVET subjects at both the CSEC and CAPE levels, so as to encourage students to see the TVET subjects as permitting viable areas of concentration at both levels.

In this regard, the French model commended by Bagnall (2000) is worth considering. According to Bagnall, the French model increased the options open to students by offering the *Bac Pro* as a genuine vocational qualification that does not restrict later movements of students into higher education. Bagnall further pointed out that the *Bac Pro* allowed those who wish to begin work immediately to have a qualification that allows for a transition directly into the workforce, while allowing others to continue with a higher education course of study if they wish to pursue that option. A programme of study at the CSEC and CAPE levels, conceptualized along the same lines, would provide greater opportunities for students to pursue TVET courses of study at both the CSEC and CAPE levels.

Conclusion

While it is evident that a larger number and proportion of students pursue the more traditional Science subjects at both CSEC and CAPE levels than the number and proportion who pursue TVET subjects at these levels, the evidence does not suggest that it is the poor-performing students who pursue TVET courses of study and examinations, compared with the type of students who take courses and examinations in the more traditional subjects.

This study was based on the performance of students in a few selected subjects over a five-year period. A more comprehensive study utilizing data over a longer period, involving all subjects offered by CXC at both the CAPE and CSEC levels, may shed further light on the nature of the population of students pursuing TVET subjects and examinations. In such a study, the TVET concept may be expanded to include subjects such as the business offerings and food and nutrition offerings of CXC, which, in a broader conceptualization of TVET, would be included in that group.

In this study, high-performing and low-performing students were defined in relation to group data for TVET and science subjects, considered separately. An analysis of how the same students performed in the two types of subjects would provide more definitive evidence on the matter of whether it is lower-ability students who pursue TVET subjects. The data set used in this study could not respond to the issue of ability of students taking the two types of subjects. This is a matter that requires further research.

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REVISITING QUALITY ASSURANCE FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET) IN THE CARIBBEAN

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Quality assurance for technical and vocational education and training (TVET) is currently quite a prominent area in the Caribbean because of the expansion of the global marketplace and the need to provide training of comparable standards to those obtained in the developed world. It is evident that quality assurance in TVET is not well understood by stakeholders in the region and as such there is need to revisit this critical aspect. This paper attempts to clarify the concept of quality assurance in TVET by discussing the various approaches employed for quality assurance of TVET. It presents examples of best practices in quality assurance of TVET, and attempts to discuss these practices in relation to approaches employed in the Caribbean. Additionally, the paper provides information on the indicators of quality of a TVET quality assurance system, and makes recommendations for implementing quality assurance measures in the TVET context for the Caribbean workforce.

Introduction/Background

As global trends continue to define our existence and how we relate to others, the issue of quality and quality assurance has become of great importance. In recent times, quality assurance bodies have gained greater prominence because of the increased demand by stakeholders in all areas to access information about goods and services from which they wish to select. Assuring quality in education has, indeed, become a top priority for providers and is currently one of the most critical elements in the development of an education system. This mechanism has served to maintain professionalism, enhance stakeholder confidence, and enable personnel in the sector to adapt to the ever-changing global environment.

There are many examples internationally of a movement towards greater quality focus. In response to poor economic conditions and dissatisfaction with the lack of responsiveness of government-based systems, as well as the need to ensure quality, the Australian Quality Training Framework (ATQF), for example, was established in 2001 as a body for providing minimum quality standards for the registration of training organizations in Australia. Since 2007, this body has gone beyond its prescriptive minimum-standards view of quality to the introduction of additional criteria called the "excellence criteria" in a new concept called "continuous improvement or reflective practice," which is outcomes-focused, nationally consistent, streamlined, and transparent (Agbola & Lambert, 2010).

In the United Kingdom, a first serious attempt to develop a nationwide qualifications framework was made in 1987 with the establishment of the National Vocational Qualifications (NVQ), which demanded the establishment of quality standards. The demand by industry for a much higher skilled workforce and the response by training providers to standards to meet international competition resulted in the establishment in 2008 of a new management paradigm called the Qualifications Credit Framework (QCF), which incorporated quality targets set against measurable performance indicators through the National Education and Training Targets (NETTs). This movement did not only raise the standards to meet international competition but also supported the government's policy objective of increasing the number of young people achieving competency at specified levels of qualification (Hodkinson & Hodkinson, 1995).

Multilateral organizations such as the World Bank (WB), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Labour Organization (ILO), and others have expressed interest in quality assurance. UNESCO, for example, in its 2012 Education for All Global Monitoring Report, which focused on youth and skills, emphasized the need to improve the quality of education. It claimed that the quality of education can be improved through leveraging private resources such as the William and Flora Hewlett Foundation and the Bill and Melinda Gates Foundation, which have since 2008 contributed to the development of the quality of education in several developing countries (UNESCO, 2012, p. 168).

The existence of quality assurance bodies such as the International Network for Quality Assurance Agencies in Higher Education (INQAAHE), which collects and disseminates information on current and developing theories and practices on the assessment, improvement, and maintenance of quality in education, provides uniformity of quality internationally. This body, in particular, promotes good practices, facilitates research into practices of quality management, provides advice and expertise in assisting with the development of new agencies, facilitates links between quality assurance bodies across borders, assists in determining standards of institutions worldwide, and alerts members to dubious accrediting practices and institutions.

In light of the establishment of these quality assurance movements and the fact that the world is becoming more inclusive and interdependent, it is evident that revisiting quality assurance for technical and vocational education and training (TVET) in the Caribbean is a critical necessity in order to meet the demands of learners and the world's marketplace.

Quality and Quality Assurance

The first proponents of quality emerged from the industrial and manufacturing sectors. Most important are contributions to the evolution of the quality movement by Walter Shewhart of Bell Laboratories in 1931; followed by W. Edwards Deming, a student of Shewart, who proposed a 14-point philosophy; Joseph Juran with steps for quality improvement; and Philip Crosby with 14 steps for quality management. Others such as Kauru Ishikawa and Genichi Taguchi also contributed to this movement in its early stages (Mishra, 2006).

The notion of quality can be viewed from various perspectives. On one hand, the British Standards Institution (BSI) has defined quality as "the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs" (1991, p. 1). Harvey and Green (1993), on the other hand, have identified five different approaches to defining quality in terms of *exceptional*, *consistency, fitness for purpose, value for money*, and *transformative.*

It is evident that these different approaches to defining quality might not yield a suitable universal definition since the concept of quality is amorphous and contextual, ranging from *standard* to *excellent*. It might therefore be instructive to draw on Garvin's (1988) group of five classifications of the various definitions of quality, as outlined by the Improvement Foundation (2011), to get a broader understanding of the concept:

1. Transcendent – quality can't be precisely defined, but we know it when we see it, or are aware of its absence when it is missing. This is not a particularly useful approach to quality if we hope to make an objective assessment of quality.
2. Product- (or attribute-) based differences in quality relate to differences in the quantity of some attributes. For example, the quality of a piece of jewellery may relate to the proportion of gold it contains, with 18 carat gold being better than nine carat gold.

3. Manufacturing- (or process-) based – quality is measured by the degree to which a product or service conforms to its intended design or specification; quality arises from the process(es) used.

4. Value-based – quality is defined by price. A quality product or service is one that provides desired performance at an acceptable cost.

5. User (or customer) – quality is the capacity to satisfy needs, wants and desires of the user(s). A product or service that doesn't fulfil user needs is unlikely to find any users. This is a context dependent, contingent approach to quality. (Introduction)

The concept of quality, according to Garvin (1988, p. 12), therefore revolves around a few central ideas, which include:

- quality as *absolute*, in which it is given and considered the highest possible standard;
- quality as *relative*, in which the quality of a service or product can be described in relative terms or measured in terms of certain specifications;
- quality as *a process*, in which the product or service must undergo certain processes and conform to procedural requirements; and
- quality as *culture*, in which the organizational view of quality as a process of transformation is recognized.

Navaratnam and O'Connor (1993) agree that quality vocational education is important to industry because employers see a skilled workforce as fundamental to getting and maintaining a competitive advantage. They assert that:

> industries want students who can understand their work, their product or their services, be creative and adaptable, and capable of becoming multi-skilled. Industries demand that vocational graduates possess vocational knowledge, skills and attitudes that are central to industrial innovation and practice. Industry needs relevant and high quality vocational education based on recent technological innovations. Quality of vocational education is important to both government and the general public. (p. 116)

The emphasis on quality in TVET has been focusing on measured achievement. Therefore, quality is being defined in terms of outcomes, the most important of which is qualifications. It is argued that any programme which leads to qualifications that are recognized and valued must have some quality components imbedded in it. It is also recognized that quality does not necessarily guarantee a good experience. The need to provide better quality is due, in part, to much greater demand from learners, a greater level of scrutiny from the public, and the need for justification for public expenditure from funding sources. This leads to the need to have quality assurance mechanisms to determine benchmarks and standards.

Coming to terms with the concept of quality appears to be quite simple when Harvey and Green's (1993) approaches towards the definition of quality, and Garvin's (1988) classification of the various definitions of quality are reviewed; however, quality assurance of TVET has proven to be quite a complex concept. Quality assurance is defined by Merriam-Webster (2012) as "the processes and procedures that systematically monitor different aspects of a service, process or facility to detect, correct and ensure that quality standards are being met." This definition is quite appropriate and supports UNESCO's (2007) definition of quality assurance as "a process of establishing stakeholder confidence that provision (input, process and outcomes) fulfils expectations or measures up to minimum requirements" (p. 16).

After much deliberation, Navaratnam and O'Connor (1993) concluded that:

> quality assurance in vocational education may depend upon several essential and inseparable components. Because the quality of learning outcomes in technical and further education (TAFE) is multi-dimensional, an emphasis must be placed on all the components to produce the desired outcomes. (p. 117)

UNESCO promotes capacity building at the regional and national levels for quality assurance and accreditation mechanisms. In 2007, UNESCO and the World Bank established a partnership that launched the Global Initiative for Quality Assurance Capacity (GIQAC) to support the evolution of quality assurance in higher education in developing countries and countries-in-transition, by facilitating and advancing the efforts of their participating inter-regional and regional quality assurance networks. In that regard, GIQAC assists emerging and existing quality assurance systems by facilitating global and regional knowledge sharing of good practices, promoting communication among a diverse set of agencies and professionals, supporting the production of analyses and guidelines, and engendering plans for long-term network sustainability. This facility is available to assist in the development of quality assurance mechanisms for TVET.

Quality Assurance in TVET

Quality assurance has become an increasingly important aspect of TVET planning and practice over the last two to three decades. The demand for TVET, coupled with the expansion and diversification of training systems, has dramatically increased the need to develop and implement more formal notions of *quality*, along with associated procedures for quality assessment, monitoring, and improvement. Quality assurance in TVET includes several activities, starting from the self-assessment of the institution and finishing with the use of the outputs of the assessment. Institutions are expected to conduct a self-assessment each year and use the result to improve their internal quality for the following year. The self-assessment report is also used as a basis for compiling the annual report of the institution.

Navaratnam and O'Connor (1993) suggested that the application of quality assurance is critical to the future of vocational education because training must be geared to the needs of individual workplaces and the graduates who seek to work in them. They asserted that employers want quality graduates, and students expect that the skills and standards required by industry are provided to them by the training providers. In general, stakeholders want quality vocational programmes and they will not be prepared to accept lower standards of quality in course content, teaching processes, and resources.

UNESCO and ILO (2002) define TVET as "the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life" (p. 7). In relation to this definition, quality assurance of TVET must address three aspects: qualifications, courses, and providers. Educational quality should be consistent with the vision and mission of national education initiatives. To achieve quality in TVET, all stakeholders must be aware of, and understand and embrace the standards established.

The Lao Peoples' Democratic Republic (PDR) (2011) viewed quality assurance for education as:

> the process of monitoring and assessment in line with defined requirements. The quality assurance system helps an institution gain confidence in its quality and gain an increase in public trust. Quality assurance may be undertaken by an external agency or through a TVET institution's own internal quality management system (QMS). Quality assurance – whether external or internal and irrespective of how quality is defined – requires established

> benchmarks against which qualifications, courses and providers can be assessed. (p. 1)

Quality assurance in TVET is an essential element in the development of this type of education both locally and internationally. Increasingly, the call for quality TVET is becoming more intense, as such delivery systems are more conscious about this element.

In Hong Kong, according to Lim (2009), the Vocational Training Council's (VTC) quality assurance system was introduced in a staged approach starting in 1998. The incremental approach had four components:

1. The Quality Policy, which sets out the institution's commitment to provide quality, and the principles and concepts (e.g., Total Quality Management) that underpin this.
2. A Quality Assurance Framework, which sets out the framework for implementing enabling management processes and the performance indicators to measure their effectiveness.
3. The Evaluation System, which measures the impact of the enabling management processes on the provision of quality learning and teaching.
4. The Internal Monitoring System, which tracks the institution's ability to implement improvement plans.

By recognizing these components' discrete units, strategic plans could be implemented to assure quality.

Lim (2009) further explains that:

> the quality assurance system was introduced in two stages, starting with the Quality Policy in 1998, followed by the Quality Assurance Framework (QAF) which was introduced in 2000 and was modeled initially on the Malcolm Baldrige Education Criteria for Performance Excellence, using only the aspects that it felt ready to adopt. It was modified later to incorporate elements of the European Foundation Excellence Model (European Foundation for Quality Management 2009) and the Singapore Quality Award Framework (SPRING Singapore 2009), which resulted in the adoption of a Plan-Do-Check-Act quality cycle. (p. 187)

Principles of a TVET Quality Assurance System

The general principles of a TVET quality assurance system are no different from that of a general quality assurance system, since the main objective is to improve quality and to build trust in the society. The quality assurance system starts with determining what the outcome should be. To accomplish this, the quality standards must first be established followed by assessments against the established standards.

Coates (2009) drew attention to TVET development, which in recent times has embraced *quality indicators* as opposed to *outcome measures* for determining success in performance. Quality indicators, according to Blom and Myers (2003), "are signs that are evidence of the presence or absence of particular qualities" (p. 14). Coates alluded to the many insights that have influenced the development of reliable and useful indicators for technical and vocational education and training. He provided a description of quality indicators that were developed to support the revised version of the AQTF. The quality indicators were developed to provide continuous improvements and external monitoring based on an evidence-based, outcomes focused approach, and were endorsed by the National Quality Council (NQC), a body responsible for quality assurance in Australia's training system. It is anticipated that such practice will enhance the quality of training processes and outcomes. The three primary quality indicators introduced by Coates were learner engagement, employer satisfaction, and competency completion.

Based on research conducted by Pascarella and Terenzini (2005) and Kuh (2008), Coates (2009) concluded that "active engagement of learners in effective training practices plays a critical role in developing high quality outcomes" (p. 521). Learner engagement was therefore developed as a quality indicator with focus on key areas of training such as high quality skill, competency development, and the quality of the individual and organizational support. The *employer satisfaction* quality indicator emphasizes the importance of the employer's opinion in determining quality, and focuses on learner/employee competency development, relevance of the learner competency to work and future training, and the overall quality of training and assessment. The *competency completion* quality indicator was developed to affirm the importance for quality management of understanding the outcomes being achieved by the registered training organizations (RTOs) (Coates, 2009).

Coates (2009) suggested that:

> the data collected using these indicators could be used to gauge how well the RTOs are meeting their clients' needs; inform data

> driven continuous improvement; provide proxy measures of education and training outcomes; provide evidence to regulatory agencies as part of their risk assessment; manage and enhance relationships with key learner and employer stakeholders; and identify areas for improvement in their training and assessment services. (p. 522)

An effective and successful TVET system is a crucial pillar for a successful economy. This perspective is shared by many sectors of the economy. To ensure success, MacDonald, Nink, and Duggan (2010) articulated six main principles to be considered: relevance to the labour market, access for trainees, quality of delivery, standardization, inclusion of soft skills, and secure and uninterrupted funding source. Quality is highlighted as an essential element in all successful TVET systems. MacDonald et al. (2010) agree that a high-quality TVET system can serve as the impetus to boost the value of the nation and its GDP in the global marketplace.

An effective education and training system for any country must be based on reliable labour market information, demand, and employer needs for that country, particularly in priority trades and occupational areas. Market-driven training requires collaboration and coordination with employers to determine the educational and training needs in order to satisfy unmet demand. This constitutes a dynamic process since demand and employer needs must keep pace with changes in technology and the availability of new skill sets. To this end, a responsive TVET system will include methods to gauge/survey employers to gather labour market information. This information will guide changes in the training of school graduates, employees in need of up-skilling, and students attending TVET colleges and similar training organizations.

Regarding access to quality TVET, it is imperative that enrolment processes for trainees be made simple and easy. Also, adequate provisions for transportation to and from TVET institutions should be put in place. TVET facilities should be established in close proximity to population centres so that adequate numbers of trainees are available for enrolment, and that strong retention and participation rates are achieved. Access, affordability, and proximity are therefore important considerations for placement of TVET infrastructure. This is of particular importance in the Caribbean because of challenges with getting from one location to another utilizing the public transportation system. It is also necessary for the training facilities to be placed near employers since staff members from key industries are sometimes called upon to participate in the training of students. These persons will ensure that training and equipment are up-to-date and relevant, thereby addressing employer needs. These attributes underpin graduate pathways to relevant and quality employment opportunities.

The quality of a TVET delivery system is essential to its success. It adds relevance to the trainees and their successful integration into the workforce. It is imperative that local industries play a part in the TVET system so that training is aligned with needs. Local industries are the key drivers of the TVET system. They work in collaboration with the operators of the country's TVET system and bring relevance to the curriculum. Linking training to certification requires a uniform framework based on:

1. competencies (including competency development frameworks);
2. standardization of competencies (as quality standards);
3. occupational standards (which define competencies and which describe good work practice) and National Occupational Standards (NOS);
4. the development of a National Qualifications Framework (NQF) as a result of NOS; and
5. certification of competencies (which brings competency-based training and competency-based assessment into a comprehensive national, regional, and international framework).

By aligning curriculum and training, a country will inevitably attract business partners and foreign investment, which will result in economic growth—currently posing a major challenge in the Caribbean. Also, the use of industry-recognized certification of workers promotes the concept of lifelong learning, since people with recognized certification will seek to maintain their skills in the techniques and methods of their trade or profession.

By adopting established TVET standards, training can be coordinated across the region so that all trainees receive similar training, thus making all trainees more marketable to employers no matter where they are within the country or region. Uniform standards also help countries adapt their systems to match global standards more closely, making the country and its workforce more globally competitive. India offers a good example of standardization in which TVET standards are not only established but enforced throughout the nation. Although some countries are inundated with many privately operated TVET institutions, the public TVET systems have adopted international standards and curricula to ensure quality and uniformity. With standardization, trainers are taught the same curricula, and similar teaching techniques are employed across a wide geographic area. This consistent and systemic training lends credibility to the courses offered. Employers will then know that the training received was of a certain standard and calibre.

The global economy's demands for soft skills such as timeliness, productivity, teamwork, and etiquette, among others, has been on the increase. In many countries, some soft skills will take time to be inculcated due to customs, culture, or other regional issues, and a movement towards global norms. In the Caribbean, this is of particular importance because of the perceived lackadaisical attitude that appears to be a characteristic feature of the people.

Secure and uninterrupted funding is imperative for a TVET system to be successful. There is need for a continuous funding stream to finance the demand for consumables and ongoing training for all stakeholders. Many TVET systems in developing nations are funded by multilateral and bilateral agencies such as USAID, World Bank, or the United Nations (UN). Although these organizations provide needed funding for TVET, the funds are typically not available over a long period of time but give developing nations the initial investment for these programmes. Public funding provided through tax arrangements such as the Human Employment and Resource Training (HEART) Trust/National Training Agency (NTA) 2% employers' tax in Jamaica is an example of a secure, uninterruptible, and sustainable funding mechanism through which TVET quality can be assured for the nation. Developing countries are well poised to train their citizens in industries that are appropriate to their country's needs, while avoiding many obstacles that developed countries have had to overcome, particularly as it relates to reliable funding of TVET.

Establishing TVET Quality Standards

The process of establishing quality standards in TVET involves the assessment of all stakeholders, including the institutions. Stakeholders such as, for example, the Technical and Vocational Education Unit (TVU) of Jamaica's Ministry of Education, the quality assurance body, the current students, the graduates, and organizations that employ graduates of the institutions are all concerned parties that must collectively work to determine the required standards. In so doing, the parties will accept ownership of the standards and will be more likely to adhere to such standards.

Formally, Quality Standard Components for TVET Institutions *has* been quite diversified across the world since the contextual realities in each domain are quite different. In order to produce an acceptable standard, an Inter-Agency Group on TVET (IAG-TVET) was established in 2009, with the aim of coordinating activities of the agencies active in the field of TVET, particularly in developing countries. This group comprised UNESCO; the Organisation for Economic Co-operation and Development (OECD); the World Bank (WB); the ILO; the European Commission (EC); the European Training Foundation (ETF); and the Asian Development Bank (ADB). In 2010, the IAG-TVET made recommendations on a set of TVET indicators that can support countries in assessing the efficiency and effectiveness of national TVET systems. This included four key interlocking components within a governance context: finance, access and participation, quality and innovation, and relevance in TVET, as set out in Table 1.

Table 1: Interlocking Components for Monitoring and Evaluating TVET Performance

Governance context

Governance considers the extent to which a TVET system, across all levels and in all the various sub-parts, is characterised by participation, transparency and accountability. Governance also raises questions concerning quality assurance and multiple voices, because new actors are assuming responsibility and taking part in decisions.

Governance structure is largely dependent on institutional arrangements and the respective roles of key stakeholders. Such considerations ultimately encourage questions about the roles that governance systems play in generating and steering the relevance, access and participation and quality/innovation components for delivery of specific models of TVET and within the available resources.

Component 1: Finance

TVET financing is largely determined by the rules and regulations whereby financial resources are collected, allocated, and managed. It largely depends on the economic situation and **available resources**, but also on the priority levels that decision makers of various types of TVET have with regard to relevance, equity and quality; and on the trade-offs stemming from those priorities. This component equally looks at capacity of the system to ensure that resources are equitable and efficiently allocated.

Component 2: Access and participation

This component considers the extent to which various types of TVET promote **equity** and **inclusion** and the implications on expanding learning opportunities for excluded groups. This is examined through the lens of *access* and *participation*. While this second component focuses on important social aims of TVET, it simultaneously has a strong relation to the relevance dimension as it prioritizes increasing the numbers of people with viable and effective opportunities to benefit from high quality TVET leading to labour market outcomes.

Component 3: Quality

This component addresses the policy options leading to a TVET system focused on the **teaching and learning process and its effectiveness**. It is a measure of the quality of any TVET programme, that it is effectively conducted and relevant in terms of meeting skill needs. Quality facilities and equipment, is also fundamental to the provision of quality TVET. Equally important, this component looks at the capacity of the systems to innovate and how teaching and learning process is a site of innovation itself, for example with rapid changes in the use of information and communication technologies. The component equally looks at the availability of a systematic approach to quality assurance in order to support practitioners and policy-makers in improving the quality of training provision, and also guide students in making choices.

Component 4: Relevance

This component considers the extent to which TVET is **responsive** to labour market needs and requirements. The related policy area to be considered here are *labour market links to TVET programmes* and *outcomes of the TVET programmes*. This component reflects the assumption that the primary and key role of TVET is to raise skills levels and to help matching skills needs at all levels in today's complex and changing labour markets. Relevance also entails the mechanisms and available capacity to understand transition from school and all types of TVET programmes to work as well as to capture labour market signals and to anticipate emerging skills needs and the extent to which this informs TVET provision.

Source: Inter-Agency Working Group on TVET Indicators (IAG-TVET), 2012, p. 7.

These components are paramount to TVET, not only in the Caribbean, but in all countries that rely on quality goods and services to stimulate their economic growth and development. In some jurisdictions, planners define quality standards using more precise elements, such as in the case of the Lao PDR (2011) where they identified 10 quality standards, grouped into three categories with 32 discrete indicators.

Halden Morris

Quality Assurance of TVET in the Caribbean

The TVET landscape has changed drastically during the last three decades in the Caribbean. Stakeholders have been, over the period, calling for better quality programmes and delivery systems to support these programmes. During this period the region has witnessed several TVET quality assurance best practices, which for the most part resulted from actions taken by several countries in the region followed by actions taken by CARICOM.

In 1990, a CARICOM regional TVET strategy was established to propel the development of TVET in the Caribbean region. This strategy provided a foundation for most countries in the region to reconsider their position on TVET and motivated them to invest significantly in their TVET system. Boodhai (n.d.) noted that National Training Agencies/TVET Councils were implemented as apex agencies to rationalize all training, and to ensure proper manpower development and centralized planning. He outlined several key milestones achieved by the region in TVET as:

- The development of a 5-level Regional Qualifications Framework representing the different levels of skill, autonomy and responsibility that correspond to levels of employment in the labour market (2003)
- The setting up of National TVET Apex Agencies namely the HEART Trust /NTA (Jamaica, 1991), the TVET Council (Barbados, 1998) and the National Training Agency (T&T, 1999)
- The setting up of the Caribbean Association of National Training Agencies (CANTA) as the implementation arm of the Regional Coordinating Mechanism for TVET (RCMTVET) (2003)
- The wide participation of Caribbean territories in major regional TVET workshops hosted by Trinidad & Tobago and Jamaica (2000-2008)
- The adoption of the CARICOM Process for Workforce Training, Assessment and Certification (2005) by the Council for Human and Social Development (COHSOD)
- The launch of a CANTA TVET Journal in conjunction with the ILO/CINTERFOR (2005)
- The agreement by COHSOD for the Caribbean Vocational Qualification (CVQ) to be used for the movement of artisans (2007)

- The setting-up of regional processes for the development of Occupational Standards and the Quality Assurance of TVET Providers (2007/08)
- The regional approval of occupational standards (first in 2003 and again in 2008)
- The implementation of a project by the Organization of American States (OAS) has developed teachers and administrators within the secondary school system in the region. They were trained as Assessors of Competency Based Education and Training as part of a School-to-Work strategy
- The recent setting up of TVET Agencies and Competency Based Systems in countries such as Antigua & Barbuda, Bahamas, Belize, Grenada, St. Kitts & Nevis, St. Lucia and Guyana, most of which are in the formative stages
- The award of the Caribbean Vocational Qualifications (CVQs) by the Caribbean Examinations Council (CXC) in the Trinidad & Tobago Secondary School system to over 1,000 students (2007/08). (pp. 4–5)

These milestones are significant in the development and implementation of quality TVET in the Caribbean region; however there is need to analyse these outcomes in relation to the new strategies that are being promoted to determine what aspects can be replicated.

Establishment of National Councils on TVET in the Caribbean

The Caribbean region recognized the need for a high-quality TVET system and the importance of establishing standards for such a system. Accordingly, agencies were established to develop, implement, and monitor these standards. The establishment of National TVET Apex Agencies, namely, the HEART Trust NTA in Jamaica (1991); the TVET Council in Barbados (1998); the National Training Agency in Trinidad and Tobago (1999); and the National Training Agency in Antigua (2012), hastened the establishment of quality assurance mechanisms for TVET in the Caribbean. The quality movement started with the formation of the National Council on Technical and Vocational Education and Training (NCTVET) in Jamaica in 1992. This was followed by the establishment of national councils in Barbados and Trinidad and Tobago in 1998 and 1999 respectively.

The Trinidad and Tobago National Training Agency (NTA) (n.d.), in recognizing the importance of quality assurance in TVET, established a body to ensure that quality targets are achieved. The components of the body, as provided by Kuboni (2002), included:

- *Curriculum development*: to support the work of providers in designing new curriculum and making changes to existing ones
- *Instructional design*: to assist providers in articulating learner needs and designing systems to support varying categories of learners
- *Systems analysis:* to engage all stakeholders in a review and evaluation of current organisational structures with a view to effecting changes as required by changing educational goals
- *Technology support services*: to facilitate access to a well-integrated technological infrastructure to support a range of functions including teaching and learning, administration, student support services and publicity
- *Quality assurance and accreditation*: to set standards to govern the operations of all aspects of the TVET programme
- *Training*: to provide ongoing professional development activities for various categories of personnel
- *Project management*: to ensure the efficient co-ordination of the various elements of the work of the organisation
- *Research and evaluation*: to carry out continual analysis and evaluation of the operations to determine areas of strength and/or weakness in the system and as a forerunner to making recommendations for improvement (p. 103)

The NTA recognized that the assurance of quality in education, and more specifically in Technical Vocational Education and Training (TVET), is a process of establishing stakeholder confidence that the training being provided (input, process and outcomes) must fulfil expectations, or measure up to threshold minimum requirements of the regionally approved Occupational Standards. The NTA further recognized that quality assurance in TVET refers to a well-documented and administered system of assessment, and internal and external verification processes, which are essential in establishing and maintaining credibility in the TVET system.

There still remains quite a significant gap in quality assurance in the Caribbean, and a great deal of work remains to be done with respect to establishing quality assurance agencies throughout the Caribbean since only four agencies have been established to date. Additionally, those already established are primarily concerned about quality assurance of TVET in their jurisdictions. It is hoped that the establishment of the Caribbean Area Network of Training Agencies (CANTA) will fill this gap.

CANTA was established primarily as the coordinating body for quality assurance of TVET in the Caribbean. In its quality assurance system, CANTA (2009) suggested that NTAs should include quality enhancement, quality audits, and periodic surveillance audits as part of their responsibility, and ensure that adequate support for external verification visits is available. Quality audits are necessary to evaluate the suitability and sufficiency of systems, approaches, and practices implemented, as outlined in the centre approval submissions required by the NTA's criteria. Periodic surveillance audits are necessary to ensure that systems are maintained in accordance with approved "TVET centre criteria" and for approved TVET programmes. TVET centres are facilities designed for facilitating the delivery of TVET programmes.

CANTA's (2009) *Quality Assurance Criteria* include policy, management system, staffing, systems of instruction, systems of assessment, health and safety, and evaluation among other sub categories. These criteria were developed based on earlier works of the NCTVET in Jamaica, and adapted by the Caribbean Community (CARICOM) as the basis for providing a solid foundation to TVET organizations in the region. CANTA has since proposed a revised strategy for quality assurance of TVET. These criteria include instructions to guide TVET institutions towards achieving approval for TVET centre approval in the Caribbean.

In 2012, CANTA proposed a new strategy for assuring quality of TVET in CARICOM. This strategy incorporated eight key quality components: redefining TVET for workforce development and economic competitiveness; integrating TVET into general education; establishing a CARICOM training system; developing labour market intelligence; expanding public awareness; incorporating career guidance and counselling mechanisms; providing appropriate instructor training; and improving the infrastructure for training. A close investigation of these quality components proposed by CANTA (2012) will reveal that there is synchonicity between the 10 components of quality and the 32 TVET quality assurance indicators provided by Lao PDR (2011). It therefore appears that the proposal will prove adequate in providing a solid basis for evaluating the quality of TVET in the Caribbean. It is anticipated that these "quality components" will be adopted and employed across the Caribbean in the implementation of the CVQ across the region.

Quality Assurance of TVET in Jamaica

An example of best practices in quality assurance in TVET in the Caribbean is the services provided by the NCTVET in Jamaica. The Council was established in 1992 to maintain the quality and integrity of the assessment and certification system for national and regional qualifications, and to assure quality in TVET for the country. The credibility of the organization was enhanced when it became a member of the Association of Commonwealth Examination and Accreditation Bodies (ACEAB), and an associate member of INQAAHE. The responsibilities of the NCTVET in Jamaica include maintaining access to an up-to-date listing and details of all available qualification plans for national and regional qualifications; auditing training centres for compliance using criteria that have been established for "Approved Centre Status"; and ensuring that all quality assurance procedures have been completed in Approved Centres before the issuing of certificates. In order to ensure continuous compliance, the NCTVET is responsible for conducting audits in Centres where queries or areas of risk to the authenticity of assessment are identified.

The NCTVET in Jamaica is also responsible for maintaining accurate records of the candidates' achievements and certificates issued. The security of the records should be ensured in accordance with legal and statutory requirements. The Council is responsible for providing confirmation of qualifications or competencies gained, upon request. In carrying out this task, the Council is required to ensure that certificates and unit recognition for learner accomplishments are issued promptly. Another responsibility is providing training and maintaining a register of auditors/verifiers and assessors, and providing feedback to Approved Centres on candidates' performance. The NCTVET in Jamaica developed the following process to assist training organizations to become "Accredited Training Organizations" (ATOs):

1. Complete and submit an <u>Application for Accreditation</u> form with the programme(s) for evaluation (or reaffirmation) to the Registrar of NCTVET.
2. Upon receipt, a Quality Assurance specialist from the NCTVET will visit the organization to conduct technical workshop.
3. At the point of readiness, the organization must complete and submit a policy and procedure manual and agree on evaluation dates.
4. The Quality Assurance unit of the NCTVET will schedule evaluation activities and the organization will be informed of all evaluation arrangements.

5. A visiting team of professionals will conduct the accreditation evaluation exercise.
6. An evaluation team report will be prepared by the Quality Assurance Unit and submitted to the organization.
7. The organization must submit a written response to the evaluation team report to the Quality Assurance Unit.
8. The team report will be submitted to the Quality Assurance Committee of the Council for review and judgment on accreditation (Jamaica NCTVET, n.d.b).

This process for accessing centre approval is outlined in a self-explanatory flow diagram presented in Figure 1.

The process begins with a voluntary application from the institution, following which a verification process is conducted before approval is either granted or denied. If approval is granted, the institution is elevated to “approved centre status” for a three-year period during which time monitoring of the institution is conducted to ensure that standards are adhered to. The institution may lose this status if the standards are not maintained. If denied, the institution may appeal the decision or reapply after the necessary improvements are made or the deficiencies corrected.

The NCTVET established quality assurance criteria for six essential systems for TVET institutions in Jamaica: management and communication, client support, qualification of trainers and assessment personnel, assessment of facilities, and assessment of activities. The *Management and Communication Criterion* is considered extremely critical since it addresses all aspects of the training centre in the provision of NVQs and Caribbean Vocational Qualifications (CVQs). This criterion begins with the establishment of clearly communicated aims and objectives for offering the programmes that are supported by the board/senior management of the institution. It addresses the implementation of policies for fair and open access with respect to provision of training and assessment. It clearly stipulates the roles, responsibilities, and authorities of the parties involved in the training and assessment activities at the Centre, as well as associated sites. It also ensures that these roles and responsibilities are clearly defined and communicated to all parties.

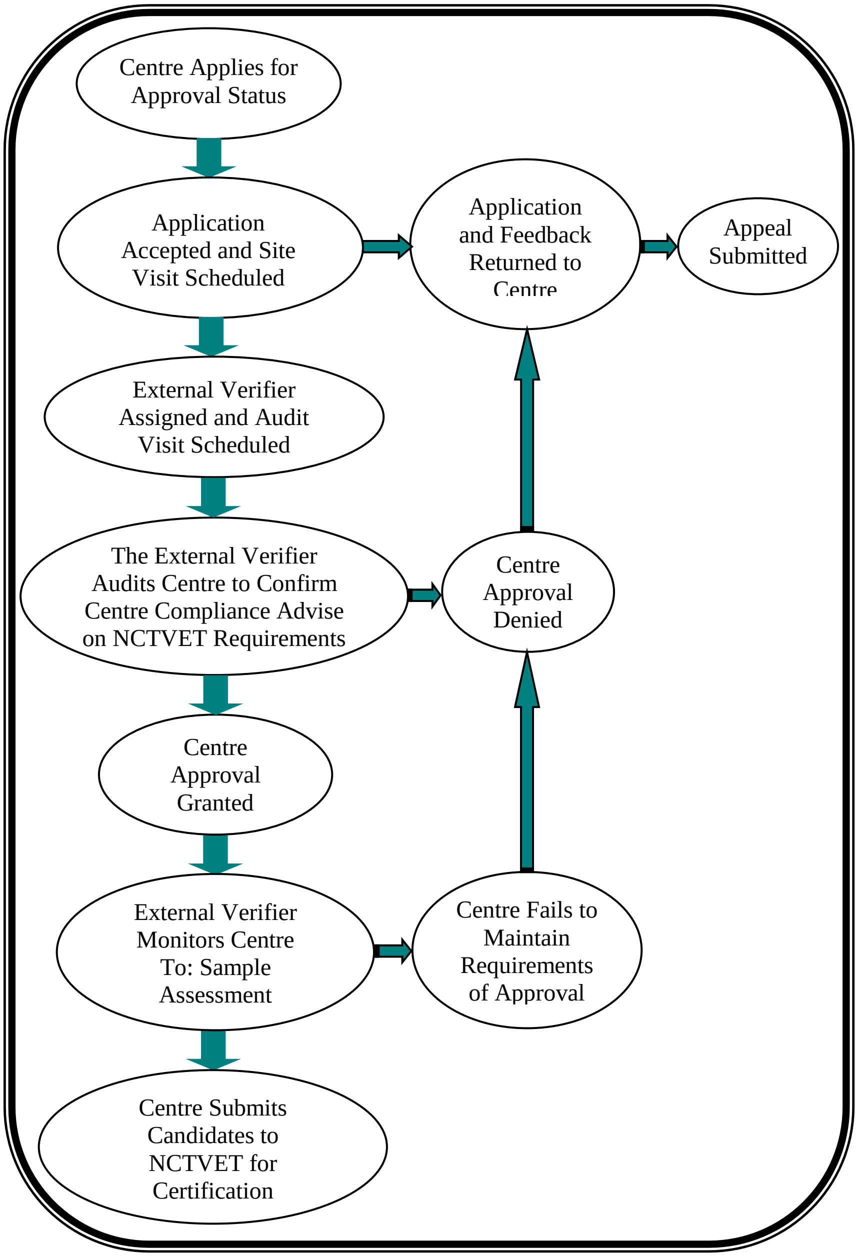

Figure 1. Centre Approval Process (*Source:* Jamaica NCTVET, n.d.a).

A major element of this criterion is the establishment of communication links between the NCTVET and the related ATO. It is recommended that an individual is appointed as a Centre Liaison to maintain effective communication between the Centre and the NCTVET. This link will ensure that internal verification procedures are clearly documented and communicated to staff and that these are consistent with the NCTVET requirements, and that the records of internal verification and other assessment activities are maintained in keeping with NCTVET requirements. Additionally, this criterion will ensure that candidates' personal and achievements records are accurate and maintained securely, confidentially, and in keeping with established guidelines. The *Management and Communication Criterion* also requires that annual reports be submitted to NCTVET on time and in the required format. Reports should include the findings of internal and external verification and the corrective action implemented. Also included are the monitoring of candidates' achievements and how this information is used to inform future developmental activities and qualifications offerings.

The *Client Support Criterion* assures that information, and advice and guidance about NVQ and CVQ training and assessment procedures, practices, and requirements are provided to candidates and potential candidates. It stipulates that guidance should be provided on how unit or full certification can contribute to the career/personal development of trainees. It also stipulates that information, advice, and support should be provided to candidates exiting the NVQ/CVQ programmes in order to support continuation of learning/assessment/certification in vocational qualifications.

The *Qualification of Trainers and Assessment Personnel Criteria* are essential in the quality assurance process. These assure that the quality of facilitators, assessors, and internal verifiers are optimum, and that the Centre has access to trained facilitators, assessors, and verifiers who are not only trained in but also practise the Competency Based Education and Training (CBET) methodology in training and assessment for NVQ and CVQ programmes. It is required that facilitators are trained and certified in their skill area to at least one level above the level that they are required to teach.

The *Assessment of Facilities Criterion* assures that the institution complies with appropriate health and safety requirements. Additionally, the equipment and material used for the purpose of assessment must also comply with established health and safety requirements. The criterion also stipulates that the equipment and materials used for conducting assessment must be provided in sufficient quantities and that they must be in good working condition to facilitate access and fairness in assessment.

A criterion that requires that *assessment activities* are planned and communicated to candidates prior to the assessment exercise is of paramount importance. Assessment and internal verification activities must be conducted by qualified and technically competent staff. These activities should employ a wide range of assessment methods in the assessment of clients. The criterion requires that records of internal verification activities must be maintained to provide evidence for queries about assessment activities and decisions. Queries should be resolved and recorded in keeping with appeal procedures. Additionally, information provided to the NCTVET must be accurate, complete, and submitted on time. It is also a requirement for the institution to provide support for external verifiers assigned by NCTVET to conduct verification activities.

The criteria established and used by the NCTVET in Jamaica have served as a mechanism to improve the quality to TVET in general. All institutions involved in the delivery of TVET must seek to gain access to these criteria and use them as a guide in their developmental activities, thus engendering the overall development of this area.

Accreditation by NCTVET in Jamaica

During the period 1991–2013, the NCTVET in Jamaica has accredited numerous institutions in several categories across Jamaica. Table 2 provides the numbers of these institutions accredited to offer some programmes at various levels of qualifications in 2006 and 2008.

In 2006, of 36 accredited institutions, only 6 were accredited to offer Level 3 programmes and none accredited to offer Level 4 programmes. By 2008, the total number of accredited institutions increased to 38 and the number of accredited institutions for Level 3 and 4 programmes increased to 13 and 1 respectively.

In 2012, a total of 38 institutions were accredited by the NCTVET, Jamaica. Included were programmes at Levels 1–4 (see Table 3). Of this number, 23 were accredited to offer Level 3 programmes, whereas, 4 were accredited to offer Level 4 programmes. This represents a significant increase in the number of institutions accredited to offer advanced level programmes.

Table 2. NCTVET Accredited Institutions in Jamaica (2006 & 2008)

Type of Institution	Total		Number Accredited						
			Level 1		Level 2		Level 3		Level 4
	2006	2008	2006	2008	2006	2008	2006	2008	2008
Vocational Training Centres	16	16	16	16	14	15	0	4	0
HEART Training Academies	7	8	7	7	7	8	3	3	0
Training Institutes (HEART)	3	1	3	1	1	1	0	0	0
Training Institutes (Private)	7	9	6	6	4	8	0	3	0
Tertiary Institution	3	3	2	2	2	2	3	3	1
Total	**36**	**37**	**34**	**32**	**28**	**34**	**6**	**13**	**1**

Source: Jamaica NCTVET, n.d.b

Table 3. NCTVET Accredited Institutions in Jamaica in 2012

Type of Institution	Total	Number Accredited			
		Level 1	Level 2	Level 3	Level 4
Vocational Training Centres	17	16	17	12	0
HEART Training Academies	6	6	6	4	2
Technical High Schools	2	2	0	0	0
Training Institutes (HEART)	3	3	3	2	0
Training Institutes (Private)	6	4	2	2	0
Tertiary Institution	4	2	3	3	2
TOTAL	**38**	**33**	**31**	**23**	**4**

Source: Jamaica NCTVET, n.d.b.

Details about the programmes that the institutions are accredited to offer can be obtained from NCTVET in Jamaica. Additionally, information on all of the NCTVET accredited institutions can be obtained from the National Qualifications register's website (www.nqrjamaica.org). It is evident that the quality assurance services provided by the NCTVET in Jamaica have proven to be an essential mechanism in the development of TVET in that country, and has led the way for quality assurance mechanisms to be developed in the rest of the Caribbean.

The quality of TVET has been significantly improved in Jamaica as a result of the establishment of the NCTVET. Prior to its inception, there was no body or organization charged with the responsibility of establishing standards and evaluating training institutions/facilities against these standards. As evidenced in Tables 2 and 3, during the last six years, there has been a steady increase in the number of institutions accredited to deliver programmes at Levels 3 and 4. In 2006, 6 institutions were accredited to offer Level 3 programmes, whereas in 2008 and 2012 the number of institutions increased to 13 and 23 respectively. Likewise, the number of institutions accredited to offer Level 4 programmes increased from zero in 2006 to 4 in 2012.

Conclusion and Recommendations

Quality assurance for TVET in the Caribbean is of utmost importance if the region is to synchronize with the global economy, which is demanding more from people across the world. Increasingly, more advanced and relevant training is becoming the expectation of stakeholders in the TVET system because of the trend of globalization. Additionally, it is well understood that an effective TVET system, as confirmed by MacDonald et al. (2010), is a crucial pillar of any successful economy. They claimed that "it can serve as the impetus to boost the value of the nation and its GDP in the global marketplace" (p. 10). It is therefore imperative that countries such as those in the Caribbean embrace appropriate quality assurance systems in the delivery of TVET.

Although the quality of TVET is primarily determined by the industry partners, the success of the system will be influenced by the availability of all stakeholder support, in particular government support, which will invariably provide a steady flow of funding, an essential component in the success and sustainability of the system. It is imperative that both the private and public sectors agree on strategies to fund quality assurance mechanisms for TVET. Government funding along with support from industry will guarantee access for trainees to the TVET system.

MacDonald et al. (2010) argue that it is important for trainees to be able to enrol easily in training programmes.

TVET needs to respond to the labour market demands in a holistic manner; as such, quality is a key element in its response. Planners need to respond to demands from all sectors of the economy, both rural and urban, and in all socio-economic conditions. TVET quality assurance systems for the Caribbean should be configured to provide quality assurance for programmes delivered in the various contexts. It is therefore imperative that standards are developed using inputs from a wide cross-section of stakeholders.

It is evident that significant strides have been made in the establishment of a quality assurance mechanism for TVET in the Caribbean. There is need, however, to place more emphasis on the coordination of the efforts of the national agencies to ensure uniformity across the region in order to establish acceptable standards. It is also necessary to benchmark regional and national standards with those established internationally to facilitate ease of migration of trained persons. This is in response to trends of globalization and its impact on the local economies.

Establishing and maintaining a culture of quality is a vision to be embraced by TVET practitioners in the Caribbean. This is an imperative to building an effective and efficient TVET system. It is of particular importance that all stakeholders are aware of the processes involved and refrain from accepting performances that have not met the established standards.

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MEASURING AND CERTIFYING SKILL AND COMPETENCE IN THE CARIBBEAN: Some Conceptual and Practical Issues

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This article tries to look deeply at skill and competence, hoping to unearth pitfalls that might obstruct the way of those who are striving towards the development of a Caribbean Vocational Qualification (CVQ) system of skills classification in the region. Aspects of the skills debate that attend the discourse on the global economy are highlighted. The problematic nature of competence is examined, especially where there is contention regarding whether or not competence can be measured. Differences between expert and novice conceptions of tasks are explored, as are differences between *techné* and phronesis. Whether the ideal of phronesis is attainable across traditional crafts is considered.

Background

Like many other countries around the globe, Caribbean countries have bought into the idea of vocational qualification ladders, where each rung supposedly represents a degree of skill attainment and, by extension, a level of competence (see a sample framework in Figure 1). The Caribbean Vocational Qualification (CVQ) schema has been adopted by the Caribbean Examinations Council (CXC), and significant numbers of secondary school students who have pursued TVET courses have been granted certificates based on CVQs. Individual countries have their own frameworks and are gradually coming around to meeting the requirements of the Caribbean-wide one. The regional aim is to operationalize the idea of a CARICOM Single Market and Economy (CSME), by creating a common skills framework to facilitate the mobility of labour across borders. CVQs are intended to standardize skill and competence such that, say, a carpenter certified in Jamaica via CVQs could find work in Trinidad and Tobago or Guyana; her CVQ communicating her ability to the employer. CVQs are intended to ensure that there is parity of skill levels, occupation by occupation, from one country to the next. This could also mean that the training systems across countries are synchronized around the same set of skill standards. That at least is the theory. The future will determine whether the CVQ approach will take hold, and if indeed it would be the ready way to assess the scope and depth of the stock of skills in the region. Moreover, it remains to be seen whether the CVQ approach can be the basis of a rise in skill levels in the region, in keeping with regional needs and global standards.

Whether the CVQ approach would enjoy wide acceptance among employers and trade unions across the region is a matter of conjecture. A concept paper on TVET pointed out numerous implementation hurdles, including lack of industry participation in the approval of skill standards, and absence of an accreditation body to support assessment activities (Boodhai, n.d.).

Level 1 - Apprentice/supervised worker - for example, a stitcher.

Level 2 - Skilled worker - for example a skilled drapery professional in a drapery company.

Level 3 - Skilled technical/supervisory worker - for example a drapery teacher, a supervisor or a sole proprietor.

Level 4 - Professional/managerial/ master craftsman - for example a manager of a drapery company.

Level 5 - Chartered professional/ managerial for example the CEO of a drapery company.

Figure 1. The Caribbean Vocational Qualification (CVQ) Scheme for Home Furnishings (A Class Draperies & Interiors Ltd., n.d.).

What countries and regions are after is improved competitiveness in the global economy, and they hope to get there by raising skill levels in the workforce. But in the discourse on competitiveness, skill has become an elusive concept, with strong social and cultural determinants, and with a decided tendency away from the technical. For example, Carnevale, Gainer, and Meltzer (1990) set forth a very influential taxonomy of skills that employers want for global competitiveness, in a framework that left out technical skill. Clarke and Winch (2006) have shown that *skill* has a different meaning in Germany than it does in the United Kingdom. In the UK, skill qualifications signal technical competence, while in Germany skill goes beyond the technical to confer social status and recognition on those who are certified (see also Brockmann, Clarke, & Winch, 2008).

What work requires of labour market entrants has almost universally settled on a set of social and intellectual attributes, such as learning how to learn, problem solving, and ability to work in teams. But these transversal abilities (Winch, 2013) alone could not yield, say, the construction boom that China has witnessed in recent decades. A reason for the unsettled nature of the discourse on skill and competence is that not all skills are public, and some are socially constructed. For example, flight attendants and bank tellers must display the emotions that go with the professional image required for these jobs. Skill for them includes a sizeable component of aesthetics. Nonaka (1991) has asserted that while some skills are explicit, and observable; others are tacit, and not easily documentable. Unions and management rarely agree on how much skill or competence inheres within particular jobs and, accordingly, on how much workers who possess demonstrable amounts of each should be compensated.

A commonplace cliché about global competitiveness is that it is premised on *high skill*. But sometimes what is meant by this is simply higher levels of education and training, or greater numbers of people in the workforce who are capable of functioning in STEM (Science, Technology, Engineering, and Mathematics) environments. In recent decades, the conversation on skill and competitiveness across countries has included comparisons of the performance of children at particular grade levels on standardized mathematics and science tests, such as the TIMSS (Trends in International Mathematics and Science Study).

Mindful of the unsettled nature of the concepts *skill* and *competence*, as suggested above, this article offers a caution for us in the Caribbean as the region proceeds in its quest to consolidate the CVQ approach. The aim is not to cast doubt upon the efficacy of this approach, but rather to suggest the need for a critical posture in assessing the capabilities of people in the region, in devising skill hierarchies, and in the administration of training programmes.

The Skill Debate

We may separate the skill debate into two reasonably distinct phases: 1) that which focused on whether skill in the workplace was being overtaken by technology, the centrepiece of which was Braverman's (1974) deskilling theory; and 2) the more recent extension of this question, which asks what skills are needed for global competitiveness. Braverman contended that the purpose of the introduction of technology in the workplace was to deny workers the autonomy and discretion that skill granted them. Technical skill was power. Spenner (1983) had defined skill not just in terms of *substantive complexity* of work performed, but the degree of autonomy and discretion that the worker is allowed to exercise on the job. Deskilling theory was suggesting that the purpose of managers when they introduced technology into the workplace was to denude the power of workers.

There is evidence now that in both blue- and white-collar occupations, technology indeed deskilled many jobs by shifting the locus of discretion away from workers to machines and to management. Many craft skills are now embedded in software. Kalleberg, Wallace, Loscocco, Leicht, & Hans-Helmut (1987) proclaimed the "eclipse of craft" in reporting a case study of technology takeover of the printing industry. This industry now has been transformed globally, with software having replaced the traditional skills of the industry, especially in the pre-press phase of the printing process. Drafting has been transformed by Computer Assisted Drawing (CAD). Machine shop crafts have now similarly been transformed with Computer Assisted Manufacturing. Sayce, Ackers, and Greene (2007) reported a case of the destruction of craft and craft identity in the carpet weaving industry with the introduction of technology. Technology has impacted not just on blue-collar work but white-collar as well. The US insurance industry is shown to have been deskilled, and hollowed out, because of the impact of the computer (Hecht, 2001).

An opposing view was that technology empowered workers, giving them more capability to accomplish their jobs. In support of this "upskilling" effect of technology, Militello and Hutton (1998) contend that in many industries technology increases the cognitive demands of jobs by performing the more routine or procedural aspects of the work, so that people could concentrate on more cognitively demanding work that requires inference, diagnoses, judgement, decision making, and problem solving. They are supported in this view by Gazarian (2013), who provides a perspective from the field of nursing. In perhaps the most compelling case offered in support of the positive effects of technology on skill, Zuboff (1984) proclaimed that up-skilling of craft in a pulp-making factory, where she documented the demise of tacit knowledge as new sensory instruments meant that workers no longer had to squeeze handfuls of pulp to determine the state of the process. The body no longer had a place in skills she proclaimed. Needed now were "intellective" skills that could be in tune with the "informating capacity" of the new technology. She illustrated the challenge for workers as they encountered this new data-driven environment where before they would rely on their own intuitive senses:

> In plants like Piney Wood and Tiger Creek, where operators have relied upon action-centered skill, management must convince the operator to leave behind a world in which things were immediately known, comprehensively sensed, and able to be acted upon directly, in order to embrace a world that is

> dominated by objective data, is moved from the action context, and requires a qualitatively different kind of response. In this new world, personal interpretations of how to make things happen count for little. The worker who has relied on intimate knowledge of a piece of equipment—the operators talk about having “pet knobs” or knowing just where to kick a machine to make it hum—feels adrift. To be effective, he must now trade immediate knowledge for more explicit understanding of the science that undergirds the operation. (p. 72)

Zuboff reports one manager in the new refurbished plant as saying:

> Once we put things under automatic control and ask them to relate to the process using the computer, their general judgments about how to relate to equipment goes by the wayside. We are saying your intuition is no longer valuable. Now you must understand the whole process and the theory behind it. (p. 72)

But Zuboff’s reading of the worth of tacit knowledge has proven to be well off the mark, as tacit skills associated with the information technology industry are now widely perceived to be the skills of highest value in workplaces, and constitute a new source of labour process tension in the workplace (see Lewis, 2013).

It is the case that, globally, we are fully in an information age in which there are more service jobs than manufacturing ones. This, arguably, might be an effect of deskilling. Technology in its various forms is central to performance everywhere—in hospitals, schools, banks, and offices; or on farms, factory floors, and construction sites. Robert Reich (1991), former US Secretary of Labor, wrote in *The Work of Nations* that in the global economy the highest premium has to be placed upon symbolic-*analytic* skills that only 20% of the American workforce possesses.

There is consensus among nations that the global economy demands high skills to deal with innovation and change. This type of skill is needed where knowledge work abounds. In their *book High Skills: Globalization, Competitiveness, and Skill Formation*, Brown, Green, and Lauder (2001) take the view that the new focus on knowledge work has caused the developed economies to increase the numbers of highly trained people for roles in technical, professional, and managerial employment. Green and Sakamoto (2001) identified four types of high skill strategies to be seen across developed countries. They point out that in the US and UK skill polarization can be observed. While many citizens get the skills needed for the global economy, many others do not.

Lloyd and Payne (2006) point out that in the UK, despite talk of high skills, the economy continues to produce low-skills—low value-added products, leading to a low skill equilibrium condition.

Ashton and Sung (2005) have found that high skills in the new economy are more likely to be found in High Performance Work Organizations, places where one would find high employee involvement practices (such as self-directed teams); human resource practices such as work re-design and mentoring; and reward and commitment practices such as family-friendly policies.

But the jury is still out on whether these types of workplaces abound, and whether they indeed require high skills. This aspect of the high skills debate raises for us in the Caribbean questions about what kinds of workplaces are needed in the region if globally competitive products and services are to be produced here. This is the demand side of the question of skill. A further question, on the supply side, is whether the current institutional infrastructure we have for delivering skill is at the level of quality required to develop world-class graduates.

Tacit skills

As indicated above, Zuboff (1984), in her book *In the Age of the Smart Machine*, provided a forecast of the impending demise of tacit knowledge at work. The era of knowledge derivation through sensory cues was at an end. Where workers would rely on the inexactness of visual, aural, or tactile cues, essentially on art, they now had to abandon these folkways to give way to the exactness of computerized instruments. But this heralding of the end of tacit knowledge has proven to be premature. Indeed, in the new knowledge economy that defines globalization, driven as it is by computers, tacit knowledge is now viewed as the kind of knowledge most prized and most associated with high value-added enterprise and innovation. On this, Nonaka (1991) has written that Japanese managers are more successful than Western ones, because they are able to tap "the tacit and often highly subjective insights, intuitions, and hunches of individual employees and making those insights available for testing and use by the company as a whole" (p. 97).

Tacit knowledge is not dead. It is as critical to industry here in the information age as it was in the craft age. It is a part of white-collar work just as it is a part of blue-collar work. Berner (2008) provides an account of skill that is premised on tacit knowledge, where the competent performer reacts and makes decisions based on bodily cues, vibrations he/she feels or hears, sluggishness observed in the movement of a machine arm, or a change in the cadence of the noise made by the machine as it flows. He writes that the skilful worker is often ahead of technological indicators. This worker can draw on a repertoire of sensory indicators, based on local history of problems, and fixes employed as correctives. The skilled worker would have created "webs of constraints and affordances that the newcomer has to understand" (p. 326). Berner goes on that:

> It is evident that understanding machines is a complex cognitive, bodily, and emotional achievement. It is also – contrary to the Taylorist notion of a 'one best way' to do a job – a variable performance, involving many individual styles and repertoires. (p. 331)

Doubtless there are classes of skilled work in the Caribbean in which tacit knowledge is the dominant mode of operating. In the currently defunct sugar industry of Trinidad and Tobago, the class of workers who were sugar boilers functioned entirely in the tacit realm. These workers objected to electronic probes being used to check the viscosity of sugar syrup, and instead relied on their senses of observation and feel to make decisions about the maturity of sugar crystals. Sugar remains vibrant in Guyana, Jamaica, and Barbados. The certification of the skills of sugar boilers could present interesting challenges. Likewise, other classes of workers across the Caribbean who have acquired competence by rote methods will present challenges at the point of assessment. Such workers will be found not just in the sugar industry, but also across typical industries such as automotive, construction, garment, and computing, among others. Deciphering tacit knowledge would be one of the key challenges for those involved in certifying mature workers and others who have not learned their skills in formal environments. Prior Learning Assessment and Recognition (PLAR) could be one of the more demanding aspects of the CVQ approach, because most of this kind of learning is in the tacit realm, where the skills are largely implicit.

The Competence Question

Competence is the other side of the coin of skill. In its plainest meaning, it is what a person is capable of accomplishing in a particular domain—the latent potential to perform. A person may be competent in cricket or football, pan tuning, fishing, playing the piano, plumbing, or medicine. Competence may be acquired formally or informally. That is, some people may acquire competence via technical school or university training. Others may do so in structured apprenticeships or by unstructured pick-up methods. In the Caribbean, some people acquire construction-related skills such as carpentry and brick laying by working among communities of practitioners on construction sites. Some gain auto-mechanic skills in automotive garages in similar fashion. Depending on the manner in which one acquires competence, its formal knowledge component may vary. Fishermen who learn their jobs by informal apprenticeships may not know navigation rules. Some pan tuners do not understand formal music. Many people who are competent in the craft realm, such as basket weaving, do not have formal theory on which they rely. In Trinidad and Tobago at an earlier time, people practised dentistry and midwifery without having formal medical training. Thus competence is made problematic by the fact that performance alone is not the full story.

Accompanying the now rampant Vocational Qualifications movement globally has been a debate about the nature and components of competence. This can be seen particularly in Australia and the UK, where a healthy exchange has ensued for the last two decades around the use of competency-based assessment in vocational education. In this debate, philosophers at the universities challenge vocational policy makers on whether competence is measureable, and whether it is educationally sound policy to conflate technical competence with educational outcomes. At the centre of the debate has been Paul Hager, the acknowledged leader of the philosophical discourse that surrounds Australian vocationalism (see, for example, Hager, 1995). Hager and his colleague David Beckett have been trying to influence vocational education in Australia away from a technicist conception of competence towards a more humanistic and holistic one (see Hager & Beckett, 1995). They have been influenced by the integrated approach taken by the professions in Australia in the assessment of competence.

Hager and Beckett (1995) contend that competence cannot be measured and must be inferred from behaviour. Assessment of competence has to be made based on a specially chosen sample of tasks. In the integrated approach it is important that one displays technical capability, but added to this are the practitioner's attributes and the character of the context of the job. In a discussion of what constitutes competence in the Australian model, Hager and Gonzi (1996) wrote that the attributes central to job performance include cognitive (e.g., critical thinking and problem solving); interpersonal; and technical skills. They contend that when these attributes are taken together with major job tasks, competency standards can be attained. There is a sense in which this so-called "integrated" view of job performance offered from Australia seems familiar, and not at all far away from the typical *affective*, *psychomotor*, and *cognitive* approach that has been the mainstay of skill conception within American vocationalism. Thus there might be some stability internationally that competence is a composite concept. But whether the component parts could be dissected is a matter of contention.

With National Vocational Qualifications in the UK as the backdrop, Gerald Lum has been a part of the competence debate, not so much opposing as offering refinements to arguments. Lum takes issue with the idea of competence as outcomes of vocational education, especially where it is to be determined on performance on a set of technical tasks. Lum (1999, 2004, 2013) contends that the technical and humanistic aspects of competence are too dissimilar to be held to constitute a single construct. One idea which unites those in the debate is that competence should not be approached from the basis of dissecting jobs into their composite elements, as is done in job and task analysis. They view this approach as “reductionist” and yielding little about the competence that is embodied in the person. They believe that much more can be yielded about job competence by looking at the performer holistically, by considering the integration of generic skills. Competence is embodied in the performer.

The philosophers who have engaged in the critique of the competency-based approach to vocational assessment betray partiality to a mind-body dualistic ontology. They see competence in terms of the immaterial and the material, mind and matter. There are the technical tasks with their exactness, and given to reductionism; then there are the cognitive attributes that are not public, but which are central to competence. In the writings of Lum we see clearly what bothers the philosophers on this count. He writes**:**

> Of all the various manifestations of human capability the least tangible and the least disposed to precise explication are those *centred in the person* (my emphasis): the understandings, the capacities for judgement, imagination, problem-solving and the host of other propensities and proficiencies that are so vital for competent action. There is thus an important sense in which the inclusion of these attributes is fundamentally *incompatible* (my emphasis) with the demand for a specification which is precise and unambiguous. (Lum, 2004, p. 489)

But on the question of what constitutes competence, the philosophers cannot reject the historical evidence of myriad pilots, dentists, surgeons, machinists, and nurses, among others, who have been trained on competency principles that take into account the elements of what they must do, what they must know, and the dispositions they must possess to be successful practitioners. The vocational educator cannot afford to hold the fear of concreteness that we see in the advocacy of the philosophers. Eventually, the crane operator must lift and safely place the container on the ship. And whether she can do this in actuality must be certified. However, the philosophers make an important point about which the vocational assessor must take heed, and it is that we have to be somewhat circumspect about how we arrive at the decision that person X is now competent enough to be hired as, say, a crane operator.

Recently, a crane destroyed a building in a famous American city, due to the error of an operator who was found to be under the influence of an illegal substance while working. The recent sinking of a cruise ship in the Mediterranean, in which several lives were lost, was due to a captain who deviated from the specified sailing procedure set in place by his employers and consistent with maritime law. These two examples highlight a side of competence not sufficiently discussed in vocational education, that is, the question of ethics. It speaks not so much about what a person can do, but about what kind of person he/she is. Can this person be trusted to act in an honest manner on a job located in a private home? Unlike the professions, the vocational occupations typically do not have codes of ethics to which initiates must subscribe. This is the case although malpractice on the part of people in craft and technician occupations could lead to the loss of life of affected people, or the destruction of property. A careless mechanic could cause a vehicle to malfunction on a hill, or on a busy highway. A careless nurse could cause a patient to overdose. This issue will surface later in the paper in the discussion of phronesis and *techné*.

Competence as lived experience

One school of thought about competence is that it must be viewed not just from observing people as they perform, but from eliciting from them the mindset they bring as they do so. Competence becomes lived experience. Benner (2000) contends that nursing competence derives from immersion in the practice. It is learned as it is enacted. An iconic study on this question is that reported by Sandberg (2000), conducted among engineers at an automotive plant. Sandberg contended that current attempts to understand competence among workers tended to be rationalistic in nature, and that multiple conceptions of competence are conceivable, including (a) that it resides in the worker, and (b) that it resides in the work itself. But Sandberg notes that rationalistic methods separate the worker from the work, and attempts are made to pre-define what competence is. But an interpretive approach rejects such a stance, reuniting the worker and work, and taking the view that competence is *the meaning that work takes on for the worker*. He notes that interpretive studies of work consistently find that the attributes brought by workers to the work depend on the work context. Using this approach, his study demonstrated that competence may indeed have to do with mindset.

All of the engineers in the study were involved in the design of cars, and were referred to as engine optimizers. The basic question had to do with how they viewed the competence required by an engine optimizer. Three groupings of engineers became possible because of their answers. The first group saw the job as optimizing each attribute of the engine, one at a time. The second group saw the job in terms of interaction of the parts. They examined the effect that optimizing a single attribute of the engine would have on others with which it was integrated. The third group approached optimizing by thinking in terms of how customers experienced the car. Sandberg followed up this phase of the study by asking participants to describe the competence of individual peers. From these results, Sandberg was able to construct a hierarchy of competence based on the level of comprehensiveness members of each group brought to their conception, with the group expressing the customer approach rated the highest, followed in order by the integrated group and the serial group. It can also be seen that by using an interpretive approach Sandberg was able to arrive at a view of competence that was in line with a core idea relating to expert knowledge, which is that experts and novices hold different *mental models* of jobs.

Expertise

Expertise is the capability of performing tasks at the highest levels of competence within a domain. The research on expertise draws distinctions between experts and novices, and the stark differences have helped to shed light on ways in which experts are distinctive. Experts are different from the novices on a number of counts. A critical one is in the relative sophistication of the mental models they hold. A mental model is the cognitive structure of the problem or task held by the performer. In the Sandberg study discussed earlier, the expert engine optimizers viewed their task from the point of view of a customer. The less accomplished ones focused upon singular engine components. Hmelo-Silver and Pfeffer (2004) found that there were differences in how experts and novices represented knowledge of a complex, interconnected system. Using a Structure–Behavior–Function (SBF) approach they found that, for the experts, the behaviour and functional realms served to represent phenomena and their relationships. For the novices, structure was more valuable. Rottman, Gentner, and Goldwater (2012) studied categorization differences between experts and novices, and found that experts sorted by causal category, while novices sorted by domain. Novices sorted fish by appearance, experts by ecological factors.

In an article in which the focus was on teaching students in science to understand complexity and to hold mental models that led to better understanding, Jacobson (2001) found that expert students, by virtue of their degree of exposure to scientific coursework, brought different epistemological and ontological insight to bear on their solution of a given environmental problem. The experts solved the problem in a non-reductive way. For them, order was the result of decentralized action. For the novices, order came from centralized control. Haerem and Rau (2007) found that experts and novices pay attention to different aspects of a task, and that this affects both their perceptions of task complexity (i.e., task analyzability and variability) and their performance on the task. Experts and novices performed the same on surface feature tasks. When the task had deep features, experts performed better.

Evidence suggests that as the degree of expertise increases with deliberate practice, repetitive and routine behaviour gives way to innovative action. Persons with greater expertise have a better cognitive picture of the task at hand, and are able to marshal more cognitive resources as they take action. In one of the pioneering studies of expertise, Chase and Simon (1973) found that expert chess players had superior memory of the game situation. They could reconstruct aspects of a game more quickly than could novices. Experts see the problem in “chunks.” They see structures and relationships not seen by novices. According to Chase and Simon, experts become so because of accumulated practice. They wrote that behind the actions of the expert lay “an extensive cognitive apparatus amassed through years of constant practice. What was once accomplished by slow, conscious deductive reasoning is now arrived at by fast, unconscious perceptual processing” (p. 56). It was their view that about 10 years of practice was needed to become expert in a particular field.

Because they feature in expert behaviour, mental models have become important as an instructional tool, and aid in student learning. It has been found that the use of a mental model in teaching how a device works improved learning of the device (Kieras & Boviar, 1984). Day, Arthur, and Gettman (2001) examined knowledge structures as a proxy for skill learning and retention, and found that the similarity of trainees' knowledge structures to an expert structure correlated with skill acquisition, and prediction of skill retention and skill transfer.

Experts have a vast storehouse of schema that are experiences encountered in the past. When they confront a situation, a quick scan reveals whether or not this lies in memory. Expertise here becomes searching for and finding solutions. This schema of past experiences can be of great help, say, in the trauma centre of a hospital, when the life of a patient is on the line. It can be the basis of quick decision making, and indeed of intuition as to the nature of the problem on hand (e.g., Kahneman, 2002).

The case of nursing

Beyond the traditional distinction between the registered and the practical nurse, there has transpired in the professional literature of nursing a discourse on the nature of nursing expertise. In North America, and probably elsewhere in the developed world, nursing has expanded its professional range considerably. One can become credentialed in two-year technical and community colleges, but also can enter a nursing education track that culminates with the doctorate. There is high demand for nurses worldwide, which has resulted in massive migrations of them from the developing to the developed world. It is not surprising then that with so much cross-border movement, the profession internationally has been preoccupied with the question of assessing nursing competence, since certification standards would vary from country to country, and the context in which nurses work would vary greatly. One major variable here is that the level of technology with which the nurse must interact routinely in developed settings is higher than in developing ones like in the Caribbean, and the margin for error is lower because developed societies are more litigious.

What makes the discussion of expertise in nursing quite interesting is the fact that, more than being a technical pursuit, nursing subscribes to an ethic of care. It is difficult to see how a nurse could become competent or expert, if he/she does not bring some order of compassion to the work. Nursing is also very much a cognitive pursuit requiring wide-ranging content and communicative knowledge. The nurse must work in a team that includes doctors of varying specialties. The dominant voice on the question of nursing expertise internationally has been that of Patricia Benner, for whom *intuition* is the primary way to distinguish the expert nurse from other nurses.

Benner (1982) drew on the work of Dreyfus and Dreyfus, who had proposed a model of skill acquisition to the US Air Force. The model was comprised of five levels: Novice, Competent, Proficient, Expert, and Mastery. The last two levels required intuitive decision making. Dreyfus and Dreyfus (1986) found that as people undergo training they pass through stages of skill acquisition, and their level of expertise increases. People also develop situational memory, which expands greatly over time. Ultimately, the performer could draw on this memory almost instinctively. This is the content of intuition. A machinist could remember a particular situation from past jobs. Thus people do not leap suddenly from declarative knowledge, *knowing that*, to procedural knowledge, *knowing how*. They come over time to the point of unconsciously recognizing new situations as being similar to remembered ones. Benner adapted the Dreyfus model of skill in proposing a skill schema for nursing that reflected the progression from novice to expert. Her model was as follows:

Level I	Novice
Level II	Advanced beginner
Level III	Competent
Level IV	Proficient
Level V	Expert

The last two levels are characterized by intuition. She described episodes where the intuition of nurses was such that they could challenge the decision making of doctors in particular situations.

Benner and Tanner (1987) delved into the role of intuition in nursing expertise, contending that it separated the novice from the expert. Intuition was "knowledge without a rationale." They distinguished between illness and disease, and the differences in human response that each required. Illness required human care—the compassion of the nurse. The skill required is in the tacit realm. Disease is in the realm of physiology, and requires scientific intervention—medicine.

This ontological stance—of disease versus illness—situated nursing at its essence in the realm of lived experience. Nursing belonged more to phenomenology than to science. The expert nurse spends more time with the patient than do doctors, and can make observations about patients by relying on cues developed over time. Their sharing of observations and hunches about patients can lead to doctors making critical pre-emptive interventions in the care of patients. Benner (1982) contended that because intuition was not an easily observable attribute, the expertise of a nurse, at higher levels, should be done on the basis of *peer review*.

Agreeing with Benner, and in line with Sandberg, Hampton (1994) conceived of expertise in nursing more in artistic than empiric terms. She argued that expert nurses do not always use conscious reasoning—that indeed they often rely on intuition, learned over time. While Benner has been the most dominant voice on the question of nursing expertise, her advocacy of intuition, and her view of nursing as belonging more in the realm of phenomenology, has not gone unchallenged. For example, Ericsson, Whyte, and Ward (2007) contend that a new approach to expertise is needed, which focuses not on nurses in most typical situations but in less frequent challenging ones, to identify superior performers. Rather than intuition, they speak of the expertise of nurses who are capable of *reproducibly superior performance*. But, like expertise, this type of performance has been attributable to extensive training and feedback. Further, nurses who produced consistently superior performance were found to have come to their expertise not by just by passive accumulation of experience, but "by active engagement in deliberate practice, where aspiring experts acquire mental representations to monitor, control, and refine their performance" (p. 11). Ericsson et al.'s view was that superior performers in nursing would be better identified by choosing not most typical situations but less frequently used ones requiring flexibility and speed. This is in line with what is known about expert behaviour (as compared to novices) as discussed earlier in this article. These types of situations are shown to reveal individual differences.

Gazarian (2013) has examined studies focused on nurses' use of the Critical Decision Method (a form of cognitive task analysis) in practice. Critical Decision Making takes into account the stressful work context in which nurses have to perform. The aim was to understand better how nurses dealt with cognitive challenges. The researcher tries to identify cues that experienced practitioners rely upon as they solve problems in the heat of action. What was the nurse seeing, hearing, smelling in the particular situation? The method accepts intuition as part of what the nurse does, and looks inside of intuition to see patterns. One finding is that nurses rely on an array of strategies when they are confronted with challenging situations. Simmons (2010) writes that nurses employ clinical reasoning methods as they make decisions under conditions of uncertainty, risk, and complexity. Nurses employ both formal and informal thinking strategies to gather patient information, evaluate its significance, and determine alternative actions. Heuristics (informal thinking strategies that are cognitive shortcuts) enable the nurse to review extensive patient information quickly by using various mental techniques.

Phronesis versus *Techné*

As indicated earlier in this article, the technical and vocational fields suffer on account of dualistic mind/body conceptions, such that the technical is often kept separate from the emotional. Concern for the client might not be viewed by the technician as a part of his/her skill set. But if a computer problem is not diagnosed and solved in reasonable time, the client's business could suffer loss. That kind of awareness on the part of the technician must be a critical aspect of his/her expertise. When the home economist offers dietary advice to clients, his/her work is thereby impacting on their health and nutrition, and quality of life. The mechanic who does not make final checks could cause a vehicle to malfunction in a manner that imperils the customer.

In *Nichomachean Ethics* (trans. 1909), Aristotle provided a way to distinguish between skill that is nakedly technical and concerned primarily with science-like exactness, which he referred to as *techné*, and skill where the bearer had a reflexive, subjective response to fellow human beings, which he referred to as *phronesis* or practical wisdom. There is now a growing literature, not just in TVET but also in teacher education and medicine, among other fields, that technical competence alone (*techné*) is an insufficient determinant of expertise, and that phronesis is the more desirable goal if the aim is thoughtful practitioners. Winch (2006) has suggested that the journey from novice to expert may be framed by the idea that the vocational learner makes the progression from *techné* to phronesis. Part of his reasoning is that phronesis has a social dimension, and that it is acquired in the context of communities of practitioners, not just by solitary toil. Breier (2009) has argued that phronesis abounds among people who have acquired expertise in non-traditional ways and who might be seeking recognition for their prior learning.

Nursing is one area of TVET that has embraced phronesis, perhaps because by its very nature it demands that practitioners embody an ethic of care. Benner (2000) addresses this dimension of nursing in a work in which she characterizes nursing expertise in moral/ethical terms, adopting Aristotle's notion of embodied competence. Benner's stance is that nursing is about thinking, but also about emotion. It is an embodied practice, she contends—a lived rather than a mastered experience. The warmth of the nurse and the compassion for the patient are not adjunct attributes; they are in fact fundamental dimensions of the nurse's expertise. She identifies seven kinds of attributes that are constitutive of the expertise of the nurse, paraphrased as follows:

1. relational skills in dealing with people in terms of their particularity
2. ability to recognize when a moral principle is at stake
3. knowledge that allows ethical comportment
4. moral deliberation and communicative skills
5. understanding of the goals and ends of good nursing practice
6. character development in the context of a community of practice
7. capacity for love and compassion

To what extent can we transfer the attributes that Benner believes to be requisite dimensions of the expertise of the nurse to other technical occupations, such as carpentry, welding, fashion designing, or home economics? TVET instruction historically has included affective aspects of jobs. But the affective domain is often the most neglected one when we observe performance on actual jobs, perhaps because technical results can often be achieved while ignoring affective concerns. Routinely one sees violations of safety regulations at construction sites, for example, people without safety glasses or hard hats, when they really should be wearing these. The phronesis approach says that the affective is not just an adornment to the craft or technician discipline, rather it has to be integral to it.

Some Reflections and Implications

The purpose of this article was to try to superimpose upon the current discourse of CVQs in the region a discourse dealing with the challenges attending the conceptualization and measuring of skill and competence. The primary hurdle of any attempt to add an agenda item to the already fully developed conversation on skill and competence in the region is that normative conceptions of these already exist. For example, if we look at the five levels of CVQ competence in Figure 1, it can be seen that the underlying logic of the CVQ is occupational hierarchy. Fundamentally, this logic, as understood in the wider society, runs roughly as follows: labourer, craftsperson, technician, Engineer, Manager. Accordingly, if, say, an electrician seeks CVQ validation of her competence, she may find that there is no room for her beyond Level II without her pursuing further training to the technician level. Further, within Level II she will find that there are no gradations of skill. Most trained electricians will find themselves locked at this level upon certification, along with others from all of the traditional craft areas, such as plumbing, welding, or masonry. There could be a bottleneck at the level.

The conversation that has unfolded in this article offers insight into what certification could look like if CVQs take on the challenge of certifying *within domains*. Thus an electrician who is already at Level II, when evaluated on the gross level may wish to find out "what level of electrician am I?" The answer to that question could reveal the person's level of skill and competence, based on an assessment on her capability on a scale from novice to expert. In some firms and industries in Trinidad and Tobago, there is a tradition for this in terms of A-Class, B-Class, and so on. Thus there are A-Class and B-Class welders, based on performance on skill tests on the job. The message of this paper is that the real work in assessment of skill in the region may have to take place within skill domains, in distinguishing where certified people lie, as they progress in their area of skill.

Another tension uncovered by the conversation in which the article engaged has to do with what is known about the difference between novices and experts in *any* domain. It is shown here that the expert thinks differently about the job at hand than does the novice, and that this difference is revealed in the nature of the mental models they employ as they think about a job at hand. This suggests a new focus in assessment, where people seeking to be tested in a skill area could be challenged with job scenarios for which they must offer graphic or verbal mental models, which would reveal the level of sophistication and creativity they would bring to the task.

Since the aim of CVQs is to certify people on the basis of evidence, and not so much on paper qualifications, it may be the case that many people seeking certification may have accumulated their competence through prior learning on the job. These people may come with tacit understandings but not necessarily formal knowledge. The challenge here, across all of the domains of assessment, would be to arrive at assessment strategies that can test tacit knowledge. Performance is obviously one approach. But, as the concerns of the philosophers who have engaged with this problem show, there is need to unearth the cognitive bases of competence that skilled people can demonstrate. Useful work done in this area through the technique of think-aloud problem solving can be seen in Johnson and Chung (1999). People possessing tacit knowledge also work from mental models that testing can uncover.

Testing and standardizing skill and competence alone will not yield a workforce that is functioning at world-class levels. Along with this there is need for industry in which skills of the new economy are required, and technical and vocational institutions that are offering training in state-of-the art facilities, taught by instructors who are up to date. The CVQ focuses on testing, and on evidence is far superior to old methods of TVET certification in the region, which ignored practical competence and placed full credence on paper and pencil tests of knowledge. But there are pitfalls in taking this approach, pertinent ones of which have been highlighted here.

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David Subran failed to gain admission to a secondary school and became instead an apprentice welder with Shell Trinidad Ltd. After serving for five years he worked in the construction industry and later became a welding instructor at a technical institute. As a consequence of coming first in the technical teacher training examinations, he was awarded the President's Gold Medal and a scholarship to pursue the B.Ed. at the Mona Campus of The University of the West Indies (UWI), following which, he completed the M.A. (Education) and the PhD (Education) at UWI, St. Augustine. David is presently a post-graduate course writer and course coordinator at UWI's Open Campus and is also a part-time lecturer at the School of Education, UWI, St. Augustine. He maintains a continuing interest in TVET research and is a frequent letter writer to the newspapers on the importance of updating TVET policies to meet the needs of the changing work environment.

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The Editorial Board of *Caribbean Curriculum* and the Guest Editor of this issue would like to extend sincere thanks to the following persons who served as reviewers for the issue. We truly appreciate their willingness to contribute to the growing corpus of quality educational literature in the Caribbean region through their thorough reviews and cogent comments, despite their heavy work schedules.

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