Improving employment outcomes of career and technical education students

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Abstract
Purpose – In this rapidly changing world, we are experiencing the fourth industrial revolution, known as “Industry 4.0,” that requires education systems to redesign qualifications in order to meet the needs of an individual and the workplace of the digitized economy. The purpose of this paper is to provide an overview of the relatively new approaches being explored mainly in the UK and Australia within the higher education (HE) sector and to propose a framework with selected career training pathways for the tertiary education system within the Australian context. The implementation plan postulated from the reports of recent studies conducted in England’s apprenticeship system is intended as a guideline for facilitating a sustainable career and technical education (CTE) with three pillars of innovation, integration and collaboration in order to improve employment outcomes required for the digitized economy in Australia.

Design/methodology/approach – This study adopts a descriptive, pragmatic research methodology to review and analyze education methods found in contemporary degree and vocation programs, particularly the degree apprenticeships adopted in England. This approach is used to explore, explain and develop a framework for student-centric apprenticeship options in CTE with graduate outcomes in the re-designed HE programs to successfully meet the needs of Industry 4.0 workplaces in Australia.

Findings – A student-centric framework is designed for HE programs with a proposal to include practical variations in apprenticeships to embrace flexible structures and industry responsiveness. The paper develops tactical plans and implementation flowcharts for the proposed framework with four CTE pathways, such as degree apprenticeships, start-up focus degrees, tailored studies and multiple majors that are designed for tertiary education programs to meet the dynamically changing employment needs of industry.

Originality/value – This proposal is a relatively new approach to improve employment outcomes of students undergoing degrees and vocational education with a focus on apprenticeship in four different forms. The strength of this pragmatic approach is in providing an insight into “what works” through a set of flexible, sustainable and practical implementation plan for the proposed CTE pathway framework in order to meet the future need of re-skilling and training for the digital economy.

Keywords Apprenticeship, Employability

Paper type General review

Introduction
Higher education (HE) is still largely operating with long-established business models as its cost continues to rise but sources of funding have eroded (Lapovsky, 2014; Glass, 2014; Mulkeen et al., 2017). Traditionally, the education society had only a few studying a university degree and fewer pursuing masters and doctoral studies. However, contemporary times have seen many more studying in universities than ever before. This is meant to help bridge the gap as developed countries have moved from a manufacturing-based workforce to a knowledge-based workforce. Similarly, industry groups have largely demanded more higher educated employees to drive creativity and new products to meet the ever changing needs of society (Lucianelli and Citro, 2017). This has caused a separation of responsibilities: universities educate and industry employs graduates. However, universities and industries are at odds with each other, one claims to be educating students to meet the current industry needs, while the other claims students’ lack of employability skills to keep in pace with the fast growing fourth industrial revolution, “Industry 4.0” or “Internet of Things” (Lorenz et al., 2015; OECD, 2016). The fundamental problem is that industry lacks
considerable involvement in HE system, from the macro level of designing the degree to the micro level of student assessment details. Labor institutions and employers should get actively involved in HE programs so as to respond quickly to the changing industry needs (Ferrández-Berrueco and Kekäle, 2014; Universities UK, 2016), The Australian Industry Group, 2016). Similarly, HE institutions should be willing to embrace change and adapt quickly to provide opportunities for career and technical skill development through partnerships with the community as they are meant for the community (Harris et al., 2010; Hanushek et al., 2017). Though this situation is witnessing a change recently in the UK with the inception of degree apprenticeships, there are many unresolved challenges (AGR & HEFCE Report, 2018; AoC Report, 2018).

Career and technical education (CTE) is a more contemporary term that replaces the traditional term “vocational education” and refers to educational programs that specialize in the skilled trades, applied science and technology and modern career preparations (Klein et al., 2014). CTE programs are offered in several forms in providing students with the opportunity to develop employability skills through work experience such as industry-based internships and certifications, job shadowing, work-integrated learning, on-the-job training, etc. A wide range of CTE programs exist as they are designed based on various parameters such as the career objective, configuration, mode of operation, location, size, field and industry type (Brooks and Kay, 2014; Apprenticeship Reform Advisory Group, 2016; Bishop and Hordern, 2017). Hence, there is no global standard framework being followed in such CTE programs offered worldwide (Ferrandez-Berrueco et al., 2016).

This study adopts a descriptive and pragmatic research approach (Tranfield and Starkey, 1998; Creswell, 2003) with an insight into “what works” (Patton, 1990) from both student and employer perspectives. In this paper, we explore, describe and develop a framework for CTE pathways in order to improve students’ employment outcomes. The rest of the paper is structured as follows: we discuss the current state of CTE programs with a primary focus on the practices adopted in Australia and the UK, as well as the need for the study in the second section. We propose a framework for CTE pathways to improve employment outcomes in the third section, and an implementation guideline in the fourth section more suitable for the Australian digital economy. Finally, the fifth section provides the conclusions and future research directions.

**Current status of CTE**

Traditionally, vocational education relates to post-secondary education that prepares an individual to become a skilled worker, such as a tradesman, a craftsman or a technician (Burke et al., 2009). In Northern Ireland, for generations, Vocational Education Committee schools provided basic education for individuals to become tradespersons or apprenticeships with core vocational skills, such as woodwork, metalwork, mechanical drawing, home economics, typing and book-keeping (ETBI Paper, 2013). While continuation education was defined as “general and practical training in preparation for employment in trades,” technical education was described as “pertaining to trades, manufacturers, commerce and other industrial pursuits.” The concept of apprenticeship subsequently evolved and the UK’s recent policy paper defines apprenticeships as paid jobs which incorporate on- and off-the-job training and a successful apprentice on completion may receive a nationally recognized qualification (Commons Briefing Paper, 2017). In Australia, apprenticeship is an occupational training program, where an apprentice is an employee right from the start with on- and off-the-job components of the training program proceeding concurrently (Knight and Karmel, 2011; Guthrie and Dowling, 2012). Thus, it is a “place and train” system and a variation is “train, place and train” if a pre-apprenticeship program is involved.
More recently, the digital economy dictates the major requirement for tertiary institutions to re-engineer their programs and provide apprenticeship opportunities that are capable of technical skill creation toward fostering the learning skills of “21st Century Skills” (OECD, 2016; AoC Report, 2018). However, research has indicated that there exists an extremely low level of awareness of such technical competency based education among employers, which creates additional hurdles in the development of apprenticeship programs to meet the fast-changing digital technology skill requirements of the industry (Franklin and Lytle, 2015). These skills are fundamental to the current and future workplace. With such an increasing requirement of technical skills for the global digital economy, CTE forms a broader apprenticeship concept required for Industry 4.0 as it integrates core academic knowledge with technical and occupational knowledge to provide students with a pathway to postsecondary education and training necessary for succeeding in their future careers (Cedefop, 2013; Lucianelli and Citro, 2017). However, in this paper we examine the evolution of CTE and its current status in many countries with a primary focus on Australia and England.

In Czech Republic and Poland, the historic strong cooperation between the universities and industry deteriorated by the end of Communist era and industry involvement through placements is being made viable at masters programs only (Ferrandez-Berrueco et al., 2016). However, new initiatives to improve cooperation between HE and the labor market are expected to result in partnerships between academic institutions and employers in future. Traditional university mode tertiary education system is still operational in Southern European countries like Spain (Ferrández-Berrueco and Kekäle, 2014).

In Australia, the vocational education and training (VET) and the HE systems have been traditionally well regarded both nationally and internationally as they continually improve their curriculum with their ongoing national review and reforms. However, recent review reports indicate that the VET sector is declining affecting mid-level tertiary education, such as associate degrees and higher-level apprenticeships (NCVER Annual Report, 2016; Apprenticeship Reform Advisory Group, 2016). There is a need for a policy and incentive for a unified funding framework with regard to resourcing Australia’s tertiary education sector spanning both VET and HE for enabling students to better “pick and mix” their skillling, work and academic experiences from VET, HE and industry WBL (Warburton, 2016). On the other hand, while there is a unified funding framework across New Zealand’s tertiary education sector, the Productivity Commission’s task is to explore “new models of tertiary education” that could be more flexible to meet the student, industry and national needs, as their existing tertiary education system displays inertia, induced by centralized and overly prescriptive governance of regulatory and funding policy (New Zealand Productivity Council, 2017).

In many parts of UK, there have been large numbers of competency-based training and qualifications, and with the privatization of the VET sector, a need has been created to reform in order to address the quality of tertiary education. The UK Government’s Post-16 Skills Plan has introduced two distinct pathways, namely a college-dominant pathway and an employer and apprenticeship pathway with 15 vocational/technical routes to choose from (UK Department for Business, Innovation and Skills and Department for Education 2016). Even though the UK has a long history of WBL than any other country, WBL in HE is in scarce. The UK has the most diverse WBL arrangements, in particular, the recent degree apprenticeships offered in England is distinctly different from apprenticeship systems adopted in Wales, Scotland and other parts of UK. Furthermore, wide variations exist in degree apprenticeship standards, for e.g., University of Chester deploys a WBL framework for the Chartered Manager Degree Apprenticeship and the inclusion of professional bodies, while Manchester Metropolitan University uses a negotiated work-based project approach, and these implications are significant to the stakeholders (Rowe et al., 2016). One of the big challenges in degree apprenticeship programs is in having clear expectations for delivery (Institute for Apprenticeships, 2017). Reflections and lessons from the apprenticeship journey
of various universities in England have harped on the need to meet the requirements of relevant apprenticeship standards (UVAC and SDN, 2017). The degree apprenticeship market space in the UK is evolving and guides for standards are being published from time to time.

Some countries like Austria, Germany and Finland have picked different models of a dual university system, some with more traditional orientation and others are more vocationally oriented. Initially WBL arrangements were created through informal interactions between an academic institution and a local employer through industry placements. Based on mutual agreements, the students’ placement period for each week could typically consist of two to three days in the company and the rest of the period in the academic institution or a 12-week period of the final year in the industry. Other cooperative models pioneered international placements across different countries even. This diversity has resulted in significant challenges in developing a suitable framework to enhance employment outcomes at the same time embrace different WBL aspects.

In the USA, the Carl D. Perkins Career and Technical Education Act of 2006 provides opportunities to people to earn certificates and degrees with a high-skilled hands-on learning experience, aiming to provide a fast track to the workforce (US Department of Education Report, 2012). Many states are replacing their former vocational education programs to CTE programs that provide stackable credits that individuals can build on through continued education. Their CTE spans secondary, postsecondary and adult education levels that develop workforce skills. However, research studies indicate that the effectiveness of the program is not evident due to lack of accuracy and completeness of the accountability data collected by different states that relate to the subsequent employment or advanced training of CTE participants (Klein et al., 2014).

Overall, a range of WBL modes exist across a variety of disciplines in tertiary education worldwide, varying in the maturity level, timing and intensity, with some curriculum designed at the institutional level, while majority offered through government and educational policy reforms. A systematic review and comparison of WBL methods and systems developed across different nations is beyond the scope of this research work as there are several differentiating factors. However, we have identified key factors to be considered for arriving at a standards-based structured CTE program as listed below:

- curriculum design;
- career areas covered;
- entry level;
- duration;
- flexible offerings (on-the-job, off-the-job, mixed modes);
- exit qualification;
- funding; and
- governance.

Though there has been an awareness for educational reform in the direction of CTE programs, some developed countries are still trying to bring WBL into practice only at the surface level. Several studies reported in literature show a variety of forms of CTE delivery with different procedures for assessments, recognition of prior learning (RPL), accountability, etc. In addition, a number of structural and human capital issues affect the CTE programs put in practice. A European Commission (2010) communiqué has clearly emphasized the need to enhance vocational programs not only to address the high youth unemployment in Europe, but also to commit toward lifelong learning. A recent international study has raised concerns about CTE programs as the analysis of micro-data
from 11 countries indicate that with technological change, the CTE gains in youth employment may be offset by less adaptability and diminished employment later in life due to lack of generic and lifelong learning skills (Hanushek et al., 2017). Hence, there is a need for a systematic and sustainable overarching framework to enhance the employment outcomes of tertiary students pursuing CTE programs that is well suited for the digital economy with flexible and adaptable apprenticeship offerings.

**Proposed framework**
We propose a CTE pathway framework in tertiary education that has been developed from the perspectives of two key stakeholders, students and employers with an emphasis on quality in learning and assessment (Tomlinson, 2008; Klein et al., 2014). It is centered on providing flexible student learning opportunities to improve their employment outcomes through three main pillars, namely innovation, integration and collaboration (Figure 1). The innovation pillar provides opportunities for new apprenticeship program offerings with creative redesign of curricula and assessment processes. The integration and collaboration pillars provide HE institutes, industry, students and other stakeholders to jointly participate in these programs and provide partnerships in sharing resources with the necessary support mechanisms. The framework provides the design and implementation guidelines for developing different options in the CTE program based on independent reviews and gaps in the current apprenticeship practices summarized in the previous section. This framework consolidates the “best practices” and “recommendations” that are pragmatic and sustainable for the digital economy. This section presents the premise of our proposed framework describing the features of the

![Figure 1. CTE pathway framework – features and success factors](image-url)
four different forms of apprenticeship as CTE pathways. The next section provides the guidelines using the main pillars of innovation, integration and collaboration as success factors for the implementation of the proposed framework.

There are many different ways of improving student learning outcomes from flip classroom to Agile Education. Most of these strategies rely heavily on motivated teachers and motivated learners who produce quality teaching material and quality work (Venkatraman, 2007; Smith, 2012). However, none really address the question – what if a student or teacher is not motivated or is sometimes motivated? Without the motivation to improve the teaching material or quality of work produced, nothing will ever get better. For teachers, appropriate incentives for innovation in pedagogical practices should be in place apart from any incentive payment schemes that are made available for employers (Commons Briefing Paper, 2017; AoC Report, 2018). While the ramifications on teacher motivation is outside the scope of this paper, it is a known fact that for tertiary students, the motivation is employability, and for the employer, the motivation is in getting the best employees who are competent in their jobs, in other words their outcomes. Hence, the common ground is in identifying learning requirements in classroom and workplace for enhancing the employment outcomes of CTE students. This forms a critical factor while developing a variety of partnerships between tertiary education institutions and employers (Mcewen et al., 2010). Some delivery models of degree apprenticeships offered in England do embrace a collaborative approach involving the key stakeholders, namely student, employer and the HE institute with ongoing assessments and intervention strategies. However, a recent study exploring the challenges and opportunities of designing and delivering degree and higher level apprenticeships in UK universities indicate that even though such partnerships among stakeholders could be operationalized through agreements, the data analysis brings out three key themes, namely program design, program delivery and graduate attributes for improving employment outcomes (Mulkeen et al., 2017).

The definition of graduate attributes under the Australian Qualifications Framework (AQF) is: “Generic learning outcomes that refer to transferable, non-discipline specific skills that a graduate may achieve through learning that have application in study, work and life contexts” (AQF Council, 2013). The four broad categories of graduate attributes in the AQF are: fundamental skills, people skills, thinking skills and personal skills that are considered lifelong learning skills. Furthermore, the AGR & HEFCE Report (2018) along with the findings from Universities UK research indicates that the number of programs and vacancies remain low and the key challenge centers around the design and development of programs and their attractiveness to students.

This paper takes a step further in addressing the aforesaid key challenges by proposing a student-centric CTE framework offering flexible training pathways based on three pillars of innovation, integration and collaboration. Our proposed model to improve employment outcomes for CTE programs offers four pathways as apprenticeship options for students to choose from:

(1) degree apprenticeships;
(2) start-up focus degrees;
(3) tailored studies; and
(4) multiple majors.

**Option 1: degree apprenticeship**

In the UK, England has implemented degree apprenticeships, where the apprentices often have pre-requisites or RPL. Similar to trade apprenticeships, students get paid to work and study. Students gain a full bachelor or master degree mostly covering different disciplines
and specialized areas. The obvious benefits for a student are not only to develop knowledge but also gain valuable industry experience as many jobs require relevant work experience.

This option allows students to gain practical hands-on skills while establishing long-term career prospects. It has the potential to address skills shortage amongst high youth unemployment (OECD, 2016). Potentially, these graduates are better trained with a wealth of practical and theoretical experiences. In addition, the attractive benefit to the students is that it is a fee-free option for their vocational training and re-skilling needs of the fourth industrial revolution or the digital economy.

The proposal in this paper is based on the same approach as the England’s degree apprenticeship but has a few modifications to better align it to the current HE graduate attributes approved by the quality and standards framework of other countries, in particular to suit Tertiary Education Quality and Standards Agency (TEQSA) and the Industry 4.0 workplace of Australia.

In the degree apprenticeship model introduced recently in England, the employers and HE institutions or providers work collaboratively to design a variety of assessments to ensure that the graduate skill set are achieved by the students through appropriate intervention strategies. Even though there is an evolving landscape with the introduction of Chartered Manager Degree Apprenticeships and industries working with government, professional bodies and sector groups where appropriate, the key challenge is centered around attractiveness to students (AGR & HEFCE Report, 2018). In addition, cost associated with the transition to the new system is an issue (AoC Report, 2018).

In our proposal, the emphasis is on student-centric achievement of a pre-set graduate attributes and meeting the required HE quality and standards for improving employment outcomes, which is in line with the key themes reported in a recent study (Mulkeen et al., 2017). We introduce additional periodic assessment and review steps to monitor whether the apprentice is on track to finish the degree or diploma successfully. An assessor (typically two) assesses the student’s progress at periodic intervals. This approach being student-centric, if the student lacks a group of generic skills or has not been covered on the job, the assessor can request for an additional learning contract for the apprentice, such as completion of a four-week personalized intensive academic program to help train the student to achieve the required learning outcomes. If only one or two skills are not being addressed, this could be requested by the education institute assessor to the organization’s apprenticeship supervisor to create a task to cover those skills in a flexible program design. The students’ learning outcomes and skills can be completed in any order as long as there is no violation of possible pre-requisites. We have developed a flowchart shown in Figure 2 that highlights the steps involved by all parties for continuous monitoring and improvement of student employment outcomes. With such a support mechanism jointly rendered by the industry and the HE institutions, the students gain confidence and trust in transitioning from a university-based mindset.

While the current growth of England’s degree apprenticeship is primarily driven by the need to meet key skills shortages of the digital economy, research studies indicate that only certain provisions such as chartered management, digital and technology solutions and engineering form the top three areas of provision and the number of programs and vacancies still remain low (AGR & HEFCE Report, 2018). We believe that the design of our proposed degree apprenticeship option could play a key role in reducing skills gaps and skills mismatches, making it attractive to all the stakeholders, more specifically to the students in Australia. The advantage of our approach is to incorporate the generic and lifelong learning skills in a flexible program design with the degree apprenticeship assessment requirements meeting the quality standards of tertiary education approved by the TEQSA in the Australian context (Apprenticeship Reform Advisory Group, 2016; Venkatraman et al, 2017). HE institutions could work jointly with employers in establishing the clarity in creating a range of new programs for building the talent strategies required for Industry 4.0.
Option 2: start-up focus degrees

In this option, students create or work on a business start-up. This education pathway is appropriate for students who have attained substantial RPL with core skills and are venture driven to achieve the advanced skills. Their assignments are effectively related to their work for a business or a business idea. The assessment of their employment outcomes is designed toward establishing a graduate skill set for a business venture and entrepreneurship.

Students still complete a degree requirement through the CTE program while building up their entrepreneurial skills, and business concept through the HE curriculum. Students are assigned a mentor from the HE institute. Each assessment is flexible such that it helps the students toward setting up a business. Milestones and targets should be specified such that students are ready to launch their companies or product idea in 2–2.5 years. Study units such as Project Management and the capstone projects would be assessed based on activities earmarked in running of their business venture.

With student-centric coaching and assessments, the students are motivated to gain skills related to a business product, venture or idea. This would require educators to be very flexible in assessments, teaching theoretical concepts but applying it to different business ventures. Similarly, businesses could approach an educational institute to train their employees to set up and deliver a business venture. This option of CTE program could also attract funding from venture capitalists and would be suitable for more mature students. The CTE assessment and review process could follow the same flowchart as provided in Figure 2.
**Option 3: tailored studies**

This is appropriate for students who are career driven in a specific area. They are after a particular skill or knowledge to position themselves for a particular type of job or to advance in their current employment. This type of specialist vocational studies are being developed in the UK with funded masters apprenticeship programs for prospective industry managers such as senior leaders and senior accountants as well as digital technology solutions studies for technology specialists (AGR & HEFCE Report, 2018). We believe that this concept could be applied to many more degree apprenticeship programs in the Australian context. Students interested in a certain field or sub-field can choose three to six subjects to obtain intermediate to advance skills in the area. For example, a student may choose only to do web programming related subjects within a Bachelor of IT degree, because they want to be a web programmer. Subjects such as operating systems or business information system are less relevant, the knowledge and skills of which they could pick up while on the job. A career-driven student questions why they are required to learn subjects (and pay for them) which does not have a direct link to their chosen career.

For example, a student aspiring to become a web programmer may choose the following subjects.

Programming $\rightarrow$ Web Development (HTML, XML, CSS, JS, PHP) $\rightarrow$ Web Application (PHP with Zend, NodeJS, JSON).

These are the key subjects within a Bachelor of IT program that strongly relate to getting a web programmer job. This option is particularly of interest to a student who already possesses a degree or is considering a career change. Similarly, this option is of interest to employers who seek their employees to upgrade to specific skills based on new business requirements or technical enhancements. Hence, a CTE pathway with this option is possible with a short duration to upgrade specific skill set. Typically, the HE institute could collaborate with the specialized industry and award joint certifications. The flowchart given in Figure 2 could be adopted for assessment and review of the specialized apprenticeship program.

If a student wishes to change or upgrade in his or her career, it would motivate the student to complete further studies using this option. This does not prepare the students for a wide range of employment options, but rather concentrates on a particular employment skill or specialized knowledge set suited for a specific role in industry.

**Option 4: multiple majors**

This option caters to a CTE pathway that could be taken up while undergoing a classroom-based HE program. Traditionally, in several universities, single majors are typically converted into double majors to increase employability in Australia (Guthrie and Dowling, 2012; Warburton, 2016). For example, Biomedical Engineering degrees often have four mathematics and four physics subjects. By completing two more mathematics and two more physics subjects a student could have a triple major with a career as biophysicist or biomedical scientist, etc. Since the basic principles in any of the additional majors have been covered in the degree curriculum, by doing an apprenticeship in the selected areas within an organization, the add-on skill set could be achieved in the multiple majors that the student wishes to undertake.

This multiple majors option enables students to extend their knowledge and skills to have a triple or quadruple major by pursuing a CTE pathway after completing HE curriculum until a specified stage or exit point. This is particularly of interest to students who are knowledge driven, looking for a career that relies on a broad knowledge base and skill set. Careers in research or inter-discipline areas would often require multiple majors with a wide range of knowledge. Here again, the assessment and review process for the CTE pathway could follow the flowchart given in Figure 2.
Implementation guidelines

We draw the implementation guidelines based on an analysis of the historic time series data of apprenticeship or traineeship programs in Australia (TAFE Directors Australia Position Papers, 2016). A comparison of the CTE programs in Australia between the year 2011 and the year 2015 is summarized in Figure 3. Overall, there has been a 13.7 percent decrease of apprentices, with 6 percent fewer commencements and 21.5 percent fewer completions. The TAFE Directors Australia recommend that a contemporary apprenticeship system is required to meet the needs of the innovation economy. This decline trend in the employment outcomes of the apprenticeship programs in Australia is similar to many countries worldwide (Klein et al., 2014; Universities UK, 2016). Recent surveys indicate that apart from barriers of employers’ inexperience with apprenticeship models, delays in funding or government approvals and insufficient support mechanisms, the key differentiating factor for student attraction and demand is the availability of a flexible CTE program design and delivery (AGR & HEFCE Report, 2018).

The Federal Government of Australia aims for an increase of 20 percent in apprentices and trainees through various CTE programs by the end of 2020. The UK Government is targeting about three million new apprenticeships by 2020. Drawn from various literature findings as reported earlier, and studies conducted on the teaching and assessment practices adopted in Australia (Becker and Park, 2011; Smith, 2012; Wahr and Venkatraman, 2017), we find that there is more scope for “innovation” in CTE program design as there are gaps yet to be filled in. Furthermore, “integration” of VET and HE sectors could be achieved through “collaboration” with industry-based apprenticeships in order to cater to the future career requirements of the digital economy. To bridge these gaps, we have included all stakeholder perspectives and have formulated certain practical steps that form a strategic implementation guideline over a three-year period for our proposed framework of CTE pathways (Figure 4).

Figure 4 shows the strategic implementation guidelines using the three pillars of innovation, integration and collaboration for CTE pathways. To start with, a pilot implementation plan could have an initial set of target cities identified with a manageable population of people who value vocational and apprenticeship education. The experiences
Year 1
- Identify barriers for integration between Higher Education and Vocational programs and industry participation. This includes analyzing the relevant higher education laws and national policy to identify potential barriers. Develop systematic reforms for CTE transformation by providing attractive funds that would promote all stakeholder participation and integration.
- The qualifications quality and standards approving authority should include representatives from all stakeholders (vocational, HE, industry and student council) in providing employment outcomes levels and achievement criteria within the proposed framework for the four CTE pathways. This should also include guidelines for the assessors for assessing the occupational competence and professional competence of the apprentices.
- Identify joint funding sources. Each country’s apprenticeship funding policies could vary. State and Federal funding available in Australia should be revisited based on the three pillars of innovation, integration and collaboration. A standardization of policies for each state and federal funding requires to be laid out catering for competitive funding for innovative transformation of programs with CTE pathways.

Year 2
- Institutions may require registration of their new CTE program associated with a degree, associate degree or diploma (change of assessment does not require approval, change of delivery mode usually does). In Australia, the Charging Framework determines fees and charges for every activity. These fees need to be supported by the Government based on the level of apprenticeship incorporated (i.e. each of the four CTE pathways may have different funding provided by the Government to the various stakeholders based on their involvement).
- Once the CTE program has been approved to be offered, the institutions will seek Expressions of Interest from potential employers (through advertisement in regional newspaper, online and other ways to market and promote the CTE program).
- The government and approving authority should reform their policies and practices to promote innovation, data sharing and integration in the CTE programs offered by the institutions. This should include the conditions for success and rewards.
- Norms should be set for formal apprentice application commencement within a CTE program. This could be based on agreements signed with potential employers who are willing to start the minimum required apprenticeships, number of years of agreement, etc.

Year 3
- Advertisement for the various CTE pathways associated with different approved vocational and HE programs will take place. Typically these programs will commence in the following academic term. The models of the apprenticeship service delivery as well as academic attributes and employability skills should be clearly outlined.
- There should be policies and audit mechanisms in place for accountability of improving employment outcomes with pre-defined performance and evaluation metrics for the CTE programs. Appropriate reporting structure on the academic outcomes and building of the technical and employability skills through the CTE programs should be clearly stated.
- Robust incentive and reward system should be in place to motivate stakeholders to exceed their performance in participation, innovation and employment outcome results of the CTE programs. Appropriate comparison of data and measurement methods should be adopted for a rigorous and labor relevant CTE programs.

Figure 4. Strategic implementation guidelines for CTE pathways
gained through the pilot run could be used to refine the steps and improve the system for subsequent larger set of states and cities for the next cycle of implementation. The feedback loop and continuous improvement strategy will help in achieving a more reliable and sustainable CTE program with improved employment outcomes.

Data sharing

The success of each of the three pillars of innovation, integration and collaboration in the above-proposed framework relies much upon data sharing at each stage of the implementation process. Both qualitative and quantitative data relating to various activities of the stakeholders such as industry, HE institutions and students could be generated at different phases of a CTE program design and delivery. Formal forums could be created for sharing best practices or experiences as well as challenges or problems faced. In order to innovatively design relevant CTE programs, there should be public access to such data collected showing evidence of skills shortage and skills identification, which should be largely based on the continuous data collection performed from time to time by different agencies. Surveys, interviews and verbal feedback are recorded and documented to further improve the program in the future. For example, in the USA, postsecondary training data are maintained by the National Student Clearinghouse, unemployment insurance wage record data are administered by different states and federal employment and military enlistment data are managed by the Federal Employment Data Exchange System. Many states have difficulty collecting longitudinal data and they are still exploring possibilities of data sharing through their Wage Record Interchange System. The USA census is far too infrequent for a reliable measure. It can hardly be used to determine industry trends (US Department of Education Report, 2012). These factors pertaining to timely and reliable data sharing could play an important role in the successful implementation of the proposed framework.

In Australia, the easiest possible way of identifying skills-gap is through the taxation office and use information it collects to determine skills and occupation trends. The taxation office in most countries usually requests for job title, occupation and salary (income). This can be collected and analyzed to identify the skills-gap. For example, by plotting data for each particular occupation every year with standard deviation, one can see the trend. If the average salary (line of best fit) is rising quicker than other occupation salaries, it could be deduced that more graduates are required to be trained in that area. Similarly, an increase in occupation such as healthcare would be able to determine that a need for training exists. Traditional systems prohibit data collection once a student transitions into the workforce. Degree apprenticeship students are already in the system. Hence, their mentors can assess the industry and learning outcomes and establish whether new skill requirements are arising to create another degree apprenticeship program for other students with the same employer. Also, apprenticeship reporting and accountability data should be utilized to measure and review performance. Suitable performance metrics of the three pillars of innovation, integration and collaboration would determine the success factors and their maturity levels achieved could serve as the basis for awarding incentives to the stakeholders. Overall, data sharing at every stage of implementation of the proposed framework would facilitate in monitoring and improving the employment outcomes of students undergoing the various pathways of the CTE programs.

Conclusions and future research directions

Traditionally, work-based learning are of different types ranging from secondary school levels to HE levels, such as intermediate apprenticeships, advanced apprenticeships, higher apprenticeships and degree apprenticeships. There is a need to uplift these apprenticeships, more importantly at tertiary education levels in order meet the fast growing needs of the
labor economy worldwide. This paper proposed a practical framework with employer and student focus to implement different forms of apprenticeships through CTE pathways in HE. The four main options proposed are: degree apprenticeships; start-up focus degrees; tailored studies; and multiple majors. The implementation guidelines based on the three pillars of the proposed framework, namely innovation, integration and collaboration along with reliable data sharing mechanisms pave way for improving the employment outcomes of CTE students and a sustainable CTE program.

This paper identifies differences in the way in which such WBL activities are designed and delivered, not only across different countries, but even within the same institution. However, for arriving at a more systematic international coverage, future research could explore these variations in depth with an aim to review, compare and summarize different practices adopted across various nations. This could result in identifying best practices and success factors as well as challenges and problems faced in an international context. Future research is also worth in exploring the motivation of each stakeholder as a success factor for improving employment outcomes. Similarly, a comparative study of factors such as teaching practices, government policies, funding sources, accountability and reporting standards could form potential directions for future research.

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Further reading


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