



Applied research in Victorian TAFEs – Case Studies





TAFE providers have extensive expertise, developed over many decades, in developing and delivering training programs that match the skill and knowledge needs of business, health and community services agencies and a myriad of other organisations. TAFE has invested energy and capability in instructional design, delivery practice and assessment models for effective training, be it on campus, online or in the workplace.

Applied research opens a new dimension in which TAFE providers can extend the impact of their industry contacts, energy, discipline knowledge and training know-how.

Applied research is activated when a TAFE industry client – large, medium, small, micro or startup – identifies a problem or promising idea and seeks TAFE’s participation in responding to it.

Applied research concentrates on technical challenges, business process bottlenecks and service delivery inefficiencies. It may also be concerned with designing high quality training programs that overcome such problems, including examining what constitutes best practice in teaching and learning. But it’s the challenge, the bottleneck, the inefficiency, the idea in a business setting that is the flywheel of applied research.

Applied research harnesses the skills and knowledge of TAFE teachers to devise solutions in collaboration with an industry client. The benefit for TAFE students is becoming active participants in resolving a live problem in their industry of study. This scenario means they can apply what they already know and can do, develop new skills, make a difference. It’s a scenario that fosters engagement, boosts learning outcomes and lifts career opportunities.

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Applied research can be a particularly valuable TAFE service to startups and to small and medium sized businesses. Businesses of this size often confront problems that need solutions in a shorter time than a detailed, long term research program can provide. Smaller businesses rarely have the financial resources to invest in long term research, and rarely have the staffing resources or capability to oversee a research program.

TAFE knows how to work with business of all sizes and all stages of development. Applying that sound understanding to collaborative applied research problem solving and idea development is an essential pathway for successful applied research.

The engine that moves along that pathway has a number of moving parts that are less familiar and need further crafting. Key among those unfamiliar moving parts are:

- developing a shared understanding across the TAFE sector about applied research pedagogy so student engagement in problem solving and idea development is maximised
- devising models of applied research support that invite many businesses or agencies to collaborate with TAFE on tackling a common challenge
- understanding how to define a problem or opportunity and how to design an efficient research program which has the fastest path to resolution.

Some TAFE teachers are already active in applied research. Sometimes it goes under other names, like prototyping, or tinkering, or applied commonsense. The great opportunity for TAFE is to grow applied research expertise across the sector and to share it for the benefit of our students and the industries we serve.

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Innovation and research connections

Winemaking at Melbourne Polytechnic

Melbourne Polytechnic's Bachelor of Agriculture and Technology offers major studies in agribusiness, agronomy, aquaculture, and viticulture and winemaking. The viticulture and winemaking stream is a grape to glass program in a sector where enterprises range from very large, vertically integrated businesses to mid-sized winemakers and small specialist growers and boutique vintners.

The viticulture and winemaking stream offers numerous examples of industry collaborations that support innovation and foster a student's innovation mindset. Examples outlined here show the Polytechnic's active industry engagement through prototyping technology, innovative water use technologies, and examining wine consumer demographics. These applied research and innovation boosting examples are integrated into the teaching and learning program across the three years of the degree. They also form part of student assessment.

A South Australian agricultural machinery supplier has collaborated with Melbourne Polytechnic to design new technology that captures volatile organic compounds (VOCs) and ethanol. In some jurisdictions, like California, VOCs are reportable emissions. Ethanol coming off fermenting wines is a reservoir of distinctive wine fragrance and flavour. The industry partner sees considerable commercial potential in a technology that can convert these residuals from waste products to reusable resources.

Developing a prototype in collaboration with an industry partner is an activity that, like other applied research projects, is fully integrated into Melbourne Polytechnic's viticulture and winemaking programs. This project seeks to retain flavours from ethanol residuals for reintroduction to the wine to both enhance it and reduce white wine refrigeration costs, and also aims to capture wastes like ethyl acetate which has uses in solvents. The next challenge for the project is to use the technology to capture CO₂ emissions from fermenting wines which could then be recycled on farm, block or winery.

Applied research projects like this provide industry grounded learning experiences, orient students to innovation as an iterative process and a competitive edge, and potentially create commercial products and services for enterprises. The prototype may or may not become a commercially viable product. Failure is one part of the innovation recipe, as is a pooling of resources. In this case, the enterprise partner supplied the initial prototype to Melbourne Polytechnic, and the Institute has provided production and analytical resources to develop proof of concept.

Entwine is the Australian wine industry's environmental assurance scheme, developed by the Australian Wine Research Institute. Entwine members provide environmental performance data to a national database that supports environmental performance monitoring and benchmarking.

As part of their study, Melbourne Polytechnic students develop sensors and other technologies and systems that help grape growers and winemakers respond to Entwine data requirements, establish baseline data about the environmental footprint of their businesses, and benchmark performance. Environmental stewardship is good for business: it builds reputation and reduces costs (for example, through better runoff management and reduced water use). Technologies and systems developed, adapted and improved by students are embraced in the Polytechnic's commercial grape growing and winery operations, incorporated into the bachelor program teaching, and introduced to industry by students during and after their studies.



Melbourne Polytechnic has converted its specialised capability in environmental monitoring technology into other possibilities. It is now partnering with a medium-sized Melbourne-based enterprise that offers environmental monitoring and reporting solutions using sensors, telemetry and integrated software. The partners are collaborating to design short courses and diploma level units for co-delivery. This strategy will introduce across the industry innovation in, for example, monitoring water quality and emissions from agriculture and winemaking. Co-design and co-delivery will also provide revenue streams for the enterprise partner, and lift the Polytechnic's recognition and reputation in the viticulture and winemaking industries.

Third year viticulture and winemaking students can elect to complete a research elective and write a thesis. In 2015, teacher Alastair Reed was lead author of a conference paper with third year student Michael Shannon and Monash University mathematician Daniel Mathews. The paper – 'Using Big Data to investigate the influence of climate and demography on wine consumer habits' – was awarded Best Paper at the American Association of Wine Economists' 9th Annual Conference. Further work on this data set will assist growers, winemakers and retail outlets to respond to consumer expectations and preferences. A liquor retail chain provided the data for this analysis.

The Bachelor of Agriculture and Technology is offered through Melbourne Polytechnic in partnership with La Trobe University. The partnership draws on expertise from La Trobe University's Food, Agriculture and Bioscience Department, and Melbourne Polytechnic's Primary Industries Department.



TAFE as an innovation diffuser in a sector dominated by SMEs

GOTAFE boatbuilding

In Victoria, boat manufacturing and maintenance is a niche industry serving domestic and international customers. Boatbuilders design and build an array of vessels from the weekend fisherman's dinghy to harbour pilot boats and sophisticated ocean-going yachts.

GOTAFE has acted as an innovation diffusion node, bringing innovation to Victoria's boatbuilding industry through training that introduces new materials and technology. The key actor in diffusion is a trainer, Phil Bovis, who has front running expertise in technology and materials which he embeds in training for apprentices. Hands-on apprenticeship training in enterprise workshops brings enterprise owners into direct contact with leading edge boatbuilding practice.



GOTAFE is the only VET provider in Victoria with the Certificate III in Marine Craft Construction on scope. There are now 28 boatbuilding enterprises employing 42 apprentices who are enrolled at GOTAFE, up from nine apprentices in 2013. Given the importance of composites in boatbuilding, in 2015 GOTAFE added the Certificate III in Engineering – Composites Trade to its scope.

It's a thin market but the quality and industry relevance of GOTAFE's training has prompted growth. That's important for an industry primarily comprised of geographically dispersed small enterprises with ageing workforces.

Introducing SMEs to innovation through apprenticeship training

Composites, one of the main boatbuilding materials, have changed dramatically in just a few years. Older composites require application of as many as ten layers, and the resins used must harden before adding new layers. It takes time, particularly when the resin is left to harden in ambient air. Introducing new composites means fewer layers that are stronger and produce an increased variety of finishes. The new composites are less costly to use. GOTAFE's apprentices learn to use new composites, and that learning is the route by which they are introduced to many small boatbuilding enterprises.

Training for boatbuilding apprentices has also served as the route for introducing many boatbuilding enterprises to closed moulding technology. Closed moulding of composites is now in commonplace use by international competitors. It consists of a range of processes and materials that reduce time, waste and environmental emissions. For example, resin infusion technology substantially reduces void and laminate defects in finished laminates.

Composites are becoming more widespread across many industry sectors, including advanced manufacturing. There is a continuing need to update skills and knowledge of composite materials and processes as they progressively replace traditional materials. Apprentices learning how to use these innovative materials and processes become aware of how their skills can transfer to other industry sectors using composites.

Staying competitive by skilling the boatbuilding workforce

These innovations are not new to the world, but they are new to Victoria's boatbuilding enterprises picking them up in their workshops as an outstanding by-product of high quality apprenticeship training. They are innovations that bring local industry into step with global best practice, improving competitiveness, reducing costs and increasing product options.

GOTAFE has recently commenced offering boatbuilding skillsets and units of competency at Certificate IV level as a response to demand from SMEs. Business owners have seen firsthand how industry leading apprenticeship training improves their products and work processes. This has encouraged them to boost workforce skills that will prompt innovation, leading to product and productivity improvements. Employees enrolling in Certificate IV training options range from those with a few years in the industry to people who have worked in boatbuilding for decades.

Partnering for innovation and training

The Boating Industry Association of Victoria (BIAV) is an instrumental partner in GOTAFE's success. In the past two years BIAV has led a renewed industry focus on training. In 2015 it launched a 48-page Boating and Marine Industry Careers Guide for distribution within the industry and across the school sector.

For the 2015 Melbourne Boat Show, BIAV with one of its members offered an unusual door prize. During the Show at the Melbourne Convention and Exhibition Centre, a new boat was fitted out onsite, raffled and towed away by one of the 30,000 visitors. GOTAFE apprentices were on deck for the fitout. The Show was also the venue for careers information events attended by more than 150 school students who heard from BIAV members and a GOTAFE apprentice. BIAV supports training in other ways too. A new section of its website is dedicated to training and employment, and its South Melbourne offices are used two days a month for theory classes attended by many GOTAFE apprentices.

The BIAV-GOTAFE partnership is fundamental to the sustainable success of Victoria's boatbuilding industry. The partnership provides a framework for ongoing innovation in a small industry sector.

Industry currency serves innovation across the economy

SMEs employing GOTAFE's apprentices range from two-person businesses in Gippsland to enterprises employing around 50 people in Melbourne's bayside. In the first 18 months of their training, GOTAFE's boatbuilding apprentices complete core units of competency common to a number of trades. The remainder of the apprenticeship focuses on units of competency specific to boatbuilding. It's in the latter half of the apprenticeship when the old mould is broken.

A key factor in GOTAFE's successful entry into the boatbuilding industry rests on the passion, teaching expertise, skills depth, skills breadth, and technology and materials savvy that Phil Bovis brings to the training. Industry currency is central to the VET sector's innovation capability, no matter how big or small the firms that VET providers work with. As GOTAFE has shown, industry currency can play an indispensable role in diffusing innovation. Incorporating an explicit applied research mission into TAFE's national role will put industry currency at the service of more enterprises.



Deepening expertise in e-learning practice

BlendED, The Gordon TAFE Experience

TAFE providers are familiar with the challenges posed by disruptive technological innovation. Digital learning technologies first emerged only in the mid-1990s. It is remarkable to think that ten years ago Learning Management Systems (LMS) were in their infancy. Developed in Australia, Moodle 1.0 was launched in mid-2003. Moodle is now a prominent player in the global LMS industry.

Despite its recent advent, e-learning it is now ubiquitous. It is now part and parcel of contemporary TAFE teaching practice, used to maximise the benefits digital technologies bring to learners, their learning outcomes and employment prospects.



The Gordon's Blended strategy

The Gordon has focused on diffusing e-learning innovation by systematically extending the hands-on capability of teachers to embed e-learning in VET delivery and assessment. The impact of, and benefits from, innovation in any industry rely on the capacity of people to absorb the new into everyday practice. Blended is The Gordon's strategic approach to expanding absorptive capacity. Blended acknowledges that introducing e-learning requires attention to both cultural and a technological change.

Blended is also wise to the commercial benefits and imperatives of maintaining pace with e-learning innovation. Anywhere, anytime, just-in-time, personalised learning is an expectation of learners and industry engaging with VET providers. Training providers without a sophisticated e-learning capability are overlooked. E-learning opens up previously unviable and accessible markets, notably among learners who are not close to a campus, or whose personal circumstances mean they cannot enrol in or complete a fully campus-based program.

Realising the potential of e-learning innovation – a practical approach

Blended is now in the midst of a three year program to deepen organisational e-learning capability, particularly in training areas with the greatest number of enrolments. Blended has constantly adapted its methodology, adopting an action research approach to seek out and scale up what works. Blended focuses on consistent engagement with teaching teams during redevelopment of training program design, learning

resources, delivery and assessment. In the early stages of implementing redesigned programs, teams are supported with specialist technology expertise, available at the end of the phone.

Induction programs for new teachers incorporate fully online components; emphasising the importance of the online environment. The Gordon's Certificate IV in TAA upgrade, and roll-out of the LLN unit, used the Institute's LMS to engage teachers in online delivery as learners in order to demonstrate the options online delivery can provide. VET Development Centre project funding assisted The Gordon to develop the delivery resources for these competencies.

BlendedED recognises benefits to teachers are critical. Training program redesign seeks to free teacher time for other priorities by minimising paperwork – among other things, marking, assessment and audit-related recordkeeping are automated.

The benefits of the learning from BlendedED have direct benefits to industry too. Geelong is home to Deakin University's Carbon Nexus Carbon Fibre pilot plant and international research and innovation hub. With the support of BlendedED, the training program for production workers incorporates targeted use of e-learning in delivery and assessment.

For regional students in The Gordon's Animal Studies courses, the BlendedED approach has resulted in interactive online self-paced resources that reduce the time each group is required on campus. Teachers can offer more courses to more students in a wider range of locations. Students appreciate the greater flexibility, and the Institute has enhanced course sustainability.

Applied research could enable BlendedED to have wider impact

The Gordon has deployed available resources to strengthen its internal e-learning capability. BlendedED maximises the benefits of innovations in digital learning that are reshaping the educational landscape. A fully developed applied research capability within the TAFE system would ensure lessons from initiatives like BlendedED have broad impact on teaching practice and provider capability. While BlendedED has amassed considerable knowledge about how to extend teacher capability, access to applied research resources could consolidate this knowledge and make it accessible in ways that strengthen the VET sector as a whole.



From idea to proof of concept

Holmesglen Institute's integrated applied research capability

When applied research is seeking to take an innovative idea to proof of concept stage, it's unsurprising that commercial-in-confidence constraints apply. This case study provides limited detail because Holmesglen is finalising project details with its industry partner. However, it is a live tale of applied research and innovation worth telling in sketch form.

A large property developer approached Holmesglen in November 2015 with an idea that could have substantial impact on the environmental sustainability of new developments. By February 2016 Holmesglen had established a 'working laboratory' in a trade workshop area, fitted out with state of the art technology provided by the client. In a span of just three months Holmesglen was ready to begin testing the idea's viability for practical application.

The industry partner's idea is disruptive in many ways. Once proof of concept is established a series of implications follow. It is likely to impact on regulatory regimes, such as the National Construction Code and requirements for licensed trades. It is likely to require amendments to property law. Adjustments to training for apprentices would ensue. The idea pushes boundaries. It also has potential to create domestic and international competitive advantage.

Compelling capabilities for partnering with industry

The industry partner is attracted to Holmesglen for many reasons. Members of its workforce, including managers, have studied at Holmesglen or hold VET qualifications from other providers – they are familiar and comfortable with the emphasis on learning-by-doing that animates vocational education and training. The Institute has worked productively with the industry partner in devising quick turnaround solutions to training for the existing workforce and in adapting apprentice training to meet onsite skill expectations. The industry partner has a strong appreciation of Holmesglen's culture, industry responsiveness, teacher expertise and state of the art training facilities. In sum, Holmesglen is a known and trusted quantity.

To the innovation process Holmesglen brings particular and compelling capabilities. There is hands-on skill and practical knowledge available through its strengths in trades training. As a key element in its delivery of higher education programs, Holmesglen has progressively developed its strength in applied research practice. It has a track record in putting theory and research know-how to work in applied learning oriented higher education.

Holmesglen regards its VET and higher education operations as interrelated activities, not as separate entities. The innovation challenge brought by its industry partner is drawing on the complementary strengths of each domain. To that fertile interconnection, Holmesglen adds its firm grasp of the industry's operating and trading environment. The grasp is deep in specific skill areas, and broad. Holmesglen offers a range of qualifications related to commercial and domestic property development – from construction and plumbing trades to architectural drafting, building surveying, quantity surveying and construction management.

Practical research know-how, rigorous research practice

This suite of aptitudes and attitudes offers a sturdy platform on which to conduct applied research – iterative, incremental testing and retesting with a specific practical outcome as the objective. The journey to proof of concept must be accompanied by planned and thorough data collection, data checking and data reporting. There is also a need to record the journey by describing it in case studies and other forms of rigorous reporting. Holmesglen is incorporating a calibrated methodology into the applied research task it has embarked upon with its property development partner.

Workforce development for 21st century workplaces

This applied research challenge also brings a range workforce development opportunities and benefits.

Apprentices and other students in both VET and higher education programs will collaborate on tasks in the ‘working laboratory’, exposing them directly to the innovation process and applied research practice. Their joint activity will develop both articulated and tacit understanding of effective problem solving in team contexts that draw on multiple skill and knowledge sets. In addition, Holmesglen will have a practical base from which to enhance training provided to the existing workforce.

Holmesglen’s teaching workforce will work with state of the art technology and develop an understanding of how that technology is deployed in industry. This opportunity takes their industry currency to the leading edge of their fields. Their expanded knowledge and industry currency will influence curriculum design and training delivery, to the benefit of future students in Holmesglen’s certificate, diploma and degree programs. The data collected and case studies produced will assist them to influence training package development so that 21st century skills are embedded in units of competency.

For Holmesglen, engagement in this and other applied research projects provides an evidence base that conveys to potential industry partners a dimension of TAFE practice that is often unrecognised.



A pivotal role in industry support, research and innovation

Kangan Institute's Textile and Fashion Hub

The Hub was created through a partnership between the Council of Textile and Fashion Industries of Australia (TFIA), Kangan Institute and AusIndustry. Now owned fully by Kangan Institute, the Hub maintains active collaboration with industry and government. TFIA is based in the Hub building and works closely with Kangan Institute through the Hub, using the facility for industry networking events and workshops. Government agencies frequently showcase the Hub to international visitors as a best practice exemplar of integrated relationships between enterprise, government and education providers.

The Hub engages with microbusinesses through to large vertical retailers. It has a particular brief to support the microbusinesses and SMEs that make up more than 85% of businesses in the textile, clothing and footwear industry.



Location, location, location

The Hub is located in Cremorne in inner Melbourne. Cremorne and surrounding areas host a thriving business community that revolves around design, communications, textiles, fibres and fashion. The precinct brings together large fashion houses (such as Sussan, Country Road and Witchery), shared workspaces (Studio Amon for creative freelancers), and fashion and textile SMEs working in areas as diverse as industrial clothing and boutique fashion. Kangan's Textile and Fashion Hub is a vibrant component of the local ecosystem. This operating context feeds the Hub's knowledge about the contemporary needs of textile and fashion SMEs across metropolitan Melbourne.

The Hub is located in an old 1950s masonry factory which eventually became part of Kangan's Richmond campus. The building was refurbished at a cost of \$1.75m and reopened as the Hub's home in late 2011. When the opportunity arises, recycling existing TAFE infrastructure is a commonsense option for public and private investment in TAFE capability for applied research, development and innovation practice.

Kangan's engagement with the industry spans decades

TFIA has represented the industry since the 1940s. Today it runs the Australian Fashion Awards and offers an industry wide platform for marketing and promoting members' products to export markets. TFIA recognised Kangan's capability as a partner and service provider, and was familiar with the strength of Kangan's longstanding textile and fashion industry links. The Institute has provided vocational education and training to a generation of textile and fashion industry workers, from entrepreneurs in inner Melbourne to factory employees in Melbourne's north. The decline of large scale textile manufacturing forced a transition to high value activities upstream from factory production.

The Hub draws on its industry profile and connections to maintain industry expertise, opportunities and networks. Recognising that personal connections and networking are vital in the fashion and textile industry, as in all industries, the Hub hosts and co-hosts industry activities and has rooms available for industry clients to run their own forums and events.

Underpinning innovation, research and SME viability

As a research and development centre, the Hub provides access to state of the art technology. It underpins innovation practice in a fast-moving arena that puts a premium on quality in design and product across a wide range of price points for a diverse customer base.

The Hub's knitting machines and technicians facilitate materials innovation by university-industry research teams. They also enable small businesses to run samples of new products and prototype new designs before going to market. The technology suite includes:

- commercial knitting machines including whole garment knitting technology that reduces waste and limits labour intensive elements of production
- digital fabric printers that work with various fabric types and replace the time consuming task of screen printing
- 3D body scanners that enable designers and makers to create whole body images from which to extract precise measurements for a garment or line of garments.

The Hub strategically positions services to entrepreneurs and SMEs so they can become acquainted with the scope of technology-assisted design and production, and develop skills in using up-to-date technology. Operating on a fee-for-service model, the Hub provides access to technical expertise on a consultancy basis or via training programs. A designer can, for example, print as little as 1 metre or up to 100+ metres on the digital fabric printer, use the knitting machines to sample just one garment, or run a production order of 300 units. High minimum orders are standard in the industry and options provided by the Hub reduce costs and increase SME viability. The Hub also provides onsite a pre-production room, seminar and training rooms, and resources including pantone swatch books and fabric libraries.

An example of a company using the Hub's facilities is a local fashion label that brings designs to the Hub's knitwear technician to make the proposed garments using the Shima whole garment knitting machine. Final samples are used to sell the collection to retailers. After retailers submit orders, the company places a production order with the Hub. Access to Hub services and technology has enabled the company to grow its Australian Made knitwear line, now stocked by major retailers like David Jones.

Skills transfer and workforce development

Hub staff have a close understanding of industry business practices and how to improve productivity and profitability while managing demanding compliance regimes and competitive design, wholesale, distribution and retail environments. This practical business knowledge is available on a consultancy basis, or via the many training programs and workshops on offer, including sustainability workshops, translating file preparation into textile design for digital printing, knitting, using design software and patternmaking. A starting point for new industry entrants is available through short weekly tours of the Hub.

Tailored training programs are also delivered to teams of product designers and developers from large vertical retailers. Targeted upskilling helps them overcome supply chain problems by equipping them with the knowledge to better communicate with offshore suppliers.



Could applied research improve the life chances of young disengaged learners?

Chisholm Institute's Berwick Technical Education Centre

Vocational education and training is central to the learning experience of many young Australians. The National Centre for Vocational Education Research reports that in 2014 VET served more than 825,000 young people aged 15-19 – more than half of young Australians in that age group. Among them are students at Berwick Technical Education Centre (TEC).

Part of Chisholm Institute, Berwick TEC offers the Victorian Certificate of Applied Learning (VCAL), and pre-apprenticeship and apprenticeship training. The TEC is one of the largest VCAL providers in Victoria's TAFE system with courses ranging from nursing and desktop publishing to traditional trades.



Berwick TEC students have often been disengaged from learning and mainstream schooling. The TEC invests energy in devising learning designs that reconnect its student community to structured and successful learning journeys. With a focus on entry level skills development and nurturing an awareness of employability skills, the TEC's programs scaffold learning in ways that increase personal confidence and convey to students tangible progress about their growing knowledge and capabilities.

Three week block placements in industry are strategically positioned towards the end of programs rather than one day per week spread across their programs of study. This means students take a more developed skillset into the workplace, can apply that skillset for an extended period, and have the opportunity to develop deeper and more enduring workplace relationships. To gain learning outcomes, TEC students participate in projects at primary schools, such as beautifying school grounds or working with a construction project team.

The TEC has established links with community organisations and other agencies. Through them, TEC students have contributed to onsite building projects, and in so doing can draw direct relationships between what they are learning and what workplaces will ask of them.

On campus, the TEC deploys adventure-based learning and project-based learning models, and embeds language, literacy and numeracy skills development and assessment across the curriculum. Skill development in the trades occurs in a multi-trade workshop, providing opportunities for students to develop insights into teamwork and integrating specific trade skills into an improved project outcome.

The TEC's approach encompasses distinctive learning environments and learning opportunities. Access to applied research resources would assist the TEC to track personal, learning and employment outcomes for young disengaged learners. Structured applied research into teaching and learning, undertaken by the TEC's teachers, would open a window on what works best for this group of learners, enabling the TEC to share its findings in a systematic way with other providers of VCAL, apprenticeship and pre-apprenticeship training. An applied research program would point the way to potential teaching and learning innovations that make a first-rate contribution to the lives of young, second chance learners.





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