EVALUATING STATISTICS EDUCATION IN VOCATIONAL EDUCATION AND TRAINING

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This paper presents the design and development of a tool for the purposes of evaluating particular aspects of statistics education in Vocational Education and Training (VET), and in so doing draws from various spheres of activity. In February 2009, a forum on Building Networks in Statistics Education was held in Brisbane and the results from a discussion group on interactions of statistics educators with employers generated issues of concern from both sides. An overview of the research that has been done in VET, and adult training in particular, indicates there are problems with some VET programs. A summary of key issues arising from industrial consultancies involving statistics education will be presented, culminating with a presentation of the evaluation tool.

INTRODUCTION

Of the 200 research summaries published by The National Centre for Vocational Education Research (NCVER) between 2005 and 2008 not one related specifically to statistics education in this sector. Similarly, almost 200 abstracts from annual conferences held by The Australian Vocational Education and Training Research Association (AVETRA) from 2007 to 2009 were examined and not one related specifically to statistics education in this sector. Clearly this is an issue that needs to be addressed if we are to have any lasting impact in this arena.

BACKGROUND

A National Forum on Building Networks in Statistics Education was held in Brisbane in 2009. The forum was part of an Australian Learning and Teaching Council Senior Fellowship grant awarded to Professor Helen MacGillivray. It was a working forum, with discussion at its core, and aimed to identify common issues, interests, challenges and resources in the learning and teaching of statistics. A break-away discussion group comprising statistics educators and employers was asked to consider the potential for co-operative interaction between themselves. The points outlined below arose as a result of these discussions.

The statistics educators found the discussion exercise difficult and focused primarily upon the difficulties associated with establishing initial contact with employers and with integration into existing tertiary programs. The main concerns raised by the statistics educators were as follows:

- *Initial Contact:* Establishing initial contact with employer groups was seen as a major concern. Various possibilities were suggested including the role of existing organisations such as IASE, SSAI, etc. Other suggestions were to set up Advisory Committees made up of employers and academic staff with regular meetings to establish networks, etc. Out of such groups potential contact between academic staff and employer groups could be established and potentially used to enhance existing academic programs.
- *University Recognition:* There was considerable concern that too often much of this external interaction work is on top of normal university workload and may be seen as detracting from research and teaching. It was strongly felt that formal recognition of such interactions with employer groups is needed, perhaps as reduced teaching loads, payments in kind, etc.
- *Integration with existing programs:* Any interaction needs to be integrated with the university teaching and/or research programs. Issues of potential assessment possibilities were discussed along with relevant visits to and from various employer groups. Projects need to fit into academic programs and be a "unit of learning" as such, as well as being manageable, pitched at appropriate levels and not absorb too much time.
- *Staff suitability:* The right sort of people need to be available; not everybody's cup of tea as various interpersonal skills are required.

In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php [© 2010 ISI/IASE]

The employer group, on the other hand, knew precisely what they wanted from such interactions with academic staff. Their main concerns included the following:

- *Relevance:* Any collaboration/interaction needs to be relevant to the employers' work program, objectives, mission statement, etc. The nature of the relationship should be aligned with company objectives and be within the grasp of those involved.
- *IP:* Ownership needs to be established at the beginning of any collaboration, and protocols for data collection, storage, access, publishing, etc need to be agreed upon by all stake holders.
- *Connection:* The connection between industry and researchers will be enhanced by showcasing from both sides and also by ensuring continuity of researchers throughout the project life.
- *Competence:* Employer groups need to be assured of the competence of the researchers to undertake the task at hand - outcome/output orientation, availability to do the work, track record of project completion, reputation, etc. If students are involved some consideration would be given to their academic capabilities as well as their inter-personal skills.
- *Value-Add - Win-Win situation:* Employer groups offer real data problems to motivate researchers (and in turn their students). At the same time there is value added to employer research, particularly for methodological skills transfer from the researcher to the employer group, where cutting edge analytical techniques are used.

LITERATURE REVIEW

Whilst specific educational research on learning statistics as part of vocational education training is very limited, there are numerous studies, papers, presentations and reports dealing with aspects of potential interest and/or application to statistics education in the VET context. Many of these provide insights into the requirements for success in both the teaching and learning of statistics as part of vocational education training. These studies and reports typically consider the more general issues associated with training, learning, relevance, and so forth. A summary of some of these follows and provides a flavour of the current research in VET.

The most prevalent types of learning opportunities provided for Australian workers were informal learning experiences, followed by non-formal short courses and in-house training (Allen Consulting Group, 2006). This is supported by various other studies (Richardson, 2004; Mawer & Jackson, 2005), which conclude that after informal on-the-job training, in-house training, or its equivalent, was the most common form of training for Australian workers, and was valued because it was immediately relevant and could be put into practice.

The Australian Industry Group (Allen Consulting Group, 2006) reported an increasing realisation by industry that their future access to the skills they felt as necessary for future growth could not be guaranteed by the outputs of the national VET system. As a result, industry felt they would have to increase their own training efforts in-house to ensure the supply of skills.

This concern regarding the effectiveness of the VET sector in meeting industry needs is also reflected in a paper by McMahon et al. (2009) who report industry's concern that its standards are devalued through delivery and assessment not conducted in accordance with their requirements. McMahon et al. state that these issues are often related to the ways in which training packages have been implemented, with insufficient attention to the institutional and human resource requirements needed to support effective use.

This seems to be at complete odds with reports from the NCVER survey on employer use and views of the VET system (NCVER, 2008), which found 85% of employers with jobs requiring vocational qualifications were satisfied, and 82% of employers with apprentices and trainees were satisfied.

Employers are primarily interested in essential technical skills and knowledge required for jobs and compliance with legislative requirements (Misko, 2006; Smith & Oczkowski, 2009). Companies do not much care if workers did or did not have any formal qualifications, unless they were required to for compliance reasons (Mawer & Jackson, (2005). These attitudes were also shared by employees. Most Australian workers want training that is informal, immediate and delivered on the job by peers or supervisors, rather than anything which reminds them of the school

environment (Marr & Hagston, 2007). Industry representatives preferred a combination of on- and off-floor training that had immediate workplace application, and also incorporated opportunities for practice and reflection. Cost of training was not seen as a deterrent provided the training was of perceived value, clearly focused upon business-specific needs, delivered with a personal approach (such as by a known facilitator), and delivered flexibly (Dawe & Nguyen, 2007).

Training and learning strategies that are needs-based, just-in-time and very interactive, are highly valued approaches to facilitating learning in enterprise-based environments (Harris, Simons, & Moore, 2005). The selection of the *'right'* people from universities or TAFE institutes for collaborative training linkages with business organisations was seen as important. In particular the need for these practitioners to quickly familiarise themselves with the environment, culture and networks relevant to the particular enterprise was emphasised. Practitioners must also be able to determine the specific requirements of an enterprise and be able to identify skill deficits and options for 'top up' training should the need arise. In addition, they need to be flexible and able to adapt training approaches to the work-flow of the enterprise, work collaboratively, and sensitively customise training methods and materials.

Mitchell (2008) recognised the need for VET practitioners to extend their existing skills and develop new skills in teaching, learning and assessment. Several critical issues associated with addressing the needs of both industry clients and individual learners were identified, including:

- customizing and personalizing training services;
- developing a deeper understanding of individuals' learning styles and preferences;
- effectively providing services and support for different learner groups (equity, e-learning, etc)
- understanding the different ways learning can occur in workplaces
- developing partnerships between external teachers and enterprise-based managers and trainers.

Mitchell suggested that VET practitioners need to be demand-driven, client-focused, responsive to industry, and be able to build client relationships, ensure customer responsiveness and support flexible delivery. Such practitioners will have a deeper knowledge of education and industry, and be more capable of customising training and devising business solutions required by enterprises and individuals.

The importance of context and of adult learning principles was mentioned by Gibb (2004) in relation to vocational education training. These have also been reported in other studies (Rogers, 1986; Ramsden 1992; Biggs & Moore 1993; Martin, 1997, 2005, 2006, 2008). Ramsden (1992) and Biggs and Moore (1993) argued that successful training programs invariably promote a deep approach to learning by relating existing knowledge to a project in hand, or drawing on knowledge from as many sources as possible via project teams. Martin (1997, 2008) concluded that the embodiment of context, adult learning and deep learning, into the structure of a training program, were key factors contributing to the success of that training program. When statistical theory is placed into the realm of work place experience, deep learning will be enhanced. Transforming the theory into practice establishes a meaningful context for the user thereby enabling better understanding and appreciation of a situation.

Werner and Bower (1995) emphasised the need to focus upon participant learning rather than teaching style. As adults we tend to learn best when support is provided for our own personal motivation, when our experiences are valued, when we are encouraged to participate, and when the training material delivered is perceived as being relevant to our daily work (Pretty et al., 1995). Self-directed learning opportunities and interactive learning environments will shift the focus from the style of the trainer or teacher to the trainee's learning. Therefore it is important to match participant competencies with the needs of the organisation.

Smith et al. (2007) reminded us that mature-aged people are the fastest growing segment of the market for vocational education and training. Further, with respect to teaching, learning and assessment issues, they noted that mature-aged workers often prefer training to be workplace-based and practical rather than classroom-based and theoretical, and to be task-related and not necessarily

leading to a qualification. Mature-age workers expect a more personal relationship from the trainer as well as respect for their experience.

Those of us teaching statistics in VET programs can learn from the research described above, particularly if we want what we do to be perceived as of value and have lasting effect. The clear message coming from this research is that as statistics educators in this arena we need to be strongly client focused rather than text-book focused or University-bound. It is not good enough for us to have a deep knowledge of statistics education; we also need to have knowledge of the industry concerned, and be more capable of customising training content and devising appropriate business solutions required by enterprises and individuals.

INDUSTRIAL CONSULTANCIES INVOLVING STATISTICS EDUCATION

Over the past 10 years or so more than a dozen companies/organizations have been consulted, primarily with the view to providing statistical training programs for their employees in an attempt to improve productivity, increase efficiencies, etc. In each case the training provided was seen as part of the VET system and consisted primarily of statistical content related to data collection and analysis, measurement systems analysis, capability studies, statistical process control, hypothesis testing and experimental design. The training was provided privately, or by a university, and on many occasions was linked with TAFE competency certificate awards, as well as a nationally accredited university post-graduate award. Some programs were obviously more successful than others, and after program evaluations, and post-mortem discussions with industry personnel, various factors emerged that were felt to have an important impact upon the success or otherwise of each training program. The following summary provides an outline of those factors thought to be important for academics interacting with employers in this context:

- *Credibility*: Sometimes for an academic this is not easy because so often the question is "What do you know about what we do here that can benefit us? After all, you're just an academic!" To establish credibility the following points may be useful
  - *History* – i.e. track record; provide evidence of involvement in previous projects, particularly ones that have been successfully completed
  - *Homework* – do some research on the company or organisation concerned; visit their website and read about their goals and objectives and what they do.
  - *Hear* what they say – i.e. let them talk, listen carefully and take notes
- *Establish Requirements:* Determine precisely what the employer really wants. This may be difficult at times because employers may not know this themselves–particularly when it comes to issues of learning, training material, participant selection, etc. It is also important for both parties to ascertain each others respective capabilities. For in-house training employers need to be able to provide adequate facilities and time release for the trainees. On the other hand, the capability of the academic to do the training is just as important. For both parties it is important to know when to walk away.
- *Plan Effectively:* Considerable attention needs to be given to timetabling and scheduling. Often this needs to be flexible, as issues will always arise. Clarify how payment is to be made, whether to the university, or personally, as this impacts workloads and scheduling. Prepare for possible publications or other research opportunities by introducing this option early.
- *Value-Add:* This is always an important part of the process of making the client feel they are in safe and reliable hands. What happens here is what goes down the grapevine so to speak. Compromises made and shortcuts taken will be simply reflected in future clients. Four key characteristics here are *availability*, *flexibility*, *transparency* and *generosity*. To be available simply means always responding to emails and phone calls. Flexibility applies to changes in scheduling, client requirements, development of training materials, etc. Transparency refers to openness and honesty in communication, and generosity implies being prepared to go the extra mile–doing the extra analysis, or spending extra time coaching someone, etc.

DEVELOPING A TOOL FOR EVALUATING STATISTICALLY-BASED VET PROGRAMS

Based upon the concerns expressed in the literature, the discussions arising from the National Forum in Brisbane, and practical experiences from a wide range of consultancies, a set of broad groupings was devised to encapsulate the key drivers for achieving success in industry-based training programs involving statistical content. These have been called *PET Groups* and include pre-planning and preparation; project selection; the training material; the venues and facilities; the trainees; the trainer; the training; the level of internal support and the degree of accountability. They are in no particular order, and form the basis of a tool currently being devised for evaluating the success or otherwise of such training programs. Each *PET-Group* has a series of related questions or statements to be answered using Likert-type scales. The responses to these are used to generate an aggregated score for each *PET-Group*. The relative importance of each group is weighted accordingly to establish a benchmark or target perceived to be required for the successful implementation of such a training program. The final result is presented as a graphic display showing where expectations have been exceeded or otherwise. This is a work in progress, and much still needs to be done to establish the validity and reliability of the items that comprise the tool.

CONCLUSION

There is a considerable body of literature dealing with teaching, learning and assessment issues related to vocational education training, and adult (mature-age) learning. Whilst there is little educational research, if any, on the learning of statistics as part of vocational education or training, there is a commonality between the generic studies described above and the current body of knowledge related to statistics education in general; a commonality that may be applied to the learning of statistics as part of vocational education or training.

We need to be familiar with the features underlying adult learning as well as the workplace context within which the knowledge/training will apply. All learning material needs to be relevant to participants' work practices if commitment is to be achieved, and as educators we need to think about the role of evaluation of participation, knowledge gained and application. The transfer of new knowledge and the skills must relate to real workplace needs.

If we are going to be successful in teaching statistics in the VET arena then we need to become like the advanced practitioner as described by Mitchell (2008). Not only do we need to be demand-driven, client-focused, and responsive to our clients, but we also need to be capable of building client relationships, ensuring customer responsiveness and supporting flexible delivery. This will require a deeper knowledge of both education and industry, and more skills in both customizing training and devising business solutions.

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