University Graduates' Quantitative Skills and Industries' Needs

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Abstract

This paper is based on a research project which aimed to conduct a comparative study of the manufacturing organizations selected randomly from both the regional and metropolitan areas of Queensland. The data was collected in 2005 as part of a Faculty of Business funded research project at the University of Southern Queensland (USQ) in Australia. The sample sizes were equal (29 industries in each case). The main purpose was to determine whether or not there was a significant difference between the industries in Toowoomba (a regional town in inland Queensland) and Ipswich (a metropolitan city close to Brisbane) in terms of their needs for quantitative skills.

The main findings have indicated that only about fifty percent of the industries regard the graduates' quantitative skills as suitable for their tasks; and there was no significant difference between the regional and metropolitan industries in terms of their requirements for quantitative skills.

Further work will address effective and practical methods of dealing with the identified gap and recommend possible solutions if needed.

Key words: Quantitative Skills, Graduate Skills, Industries' Needs

Introduction

Businesses need to make decisions in a systematic manner. For instance, they need to forecast the demand for a product or usage of a certain type of material in the future. They also need to allocate resources to different areas (sections or projects) in such a way that they gain the most beneficial outcome. To what extent the industries rely on these techniques to manage and allocate their resources to achieve optimal results needs to be investigated.

Many industries have become aware of their needs and have started to adjust their requirements in terms of employee skills. The concept of "employability" and how that translates into tertiary course development has become a major topic throughout the world. The European community is developing benchmarks for course design through their Quality Assessment Agency (QAA). In South Africa a Chief Research Specialist for the Human Sciences Research Council includes in her paper that "The tacit skills, knowledge, and attitudes formerly developed through work experience are now expected to be an integral part of higher education programmes and curricula…" (Kruss, 2004, p.673). An Australian study (Department of Education, Science and Training 2002, Employability Skills for the Future) was funded by the Department of Education, Science and Training (DEST) and the Australian National Training Authority (ANTA). The purpose of that review was to obtain industry's view of what constituted "employability" and that these findings be provided to the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), the Australian Vice-Chancellors' Committee (AV-CC) the National Training Quality Council (NTQC) for review and implementation.

Theoretical Framework

It should be remembered that the ultimate goal is to produce graduates who meet the needs of the employers. In achieving this objective, the necessary standards and educational needs of the universities should also be taken into consideration.

Hovis and Hovis (2004) discuss the recommendations of a project on ways of satisfying the traditional needs of mathematics education with a view to responding to the technical challenges in an emerging technologies era. Recent research findings indicate that students prefer and benefit from visually rich methods of teaching in quantitative subjects. For details see Nooriafshar et al (2004); and Nooriafshar and Todhunter (2004). It is interesting to note that the use of analogies and visual features in teaching materials are identified as ways of encouraging learners to become "whole-brained", see Funderstanding (n.d.). In other words, the right brain is invoked through creative activities such as the visual features. Hence, we would not just use the part of the brain which is referred to as "50% of the brain's mighty toolkit" by Buzon (2002).

The constructivist approach to learning is also an effective way of conveying the underlying concepts to students. Constructivism encourages the learner to construct their own meanings rather than simply memorizing someone else's. It should be remembered that the general concept of "constructivism" is quite simple and practical and the underlying theory, perhaps, goes back to the Socratic times. The concept of guiding and leading the learner to find out the solution or the right answer to a problem was discussed by Plato (the ancient scholar) almost 2400 years ago. If we analyse Plato's famous "dialogue" Meno, we will realise that Socrates demonstrates to Meno how a mathematically ignorant person solves a geometrical problem through a controlled guidance procedure rather than being told directly. For an appropriate definition of learning under constructivism see Bruner (n.d.) who considers learning as an active process in which the new ideas or concepts are constructed based on the existing ones. Teaching mathematics thematically, which is also based on constructivist ideas, is reported by Handal and Bobis (2003).

It should be noted that a rich learning environment such as an interactive multimedia would also satisfy a major objective of the constructivist approach (Phillips, 1998). See Bruner (n.d.), Dougiamas (1998) and Mahoney (2004) for some examples of an introduction to constructivism. Hence, the courses should be designed in such a way that they meet the needs of the industry as well as the educational institutions.

Objectives

Preliminary work was limited to the regional area (Toowoomba) and included both goods producing and service providing organisations. The initial analysis indicated that there was no significant difference between the service and good producing companies and they, generally, would have a common practice, and thinking towards their needs and tertiary courses in quantitative subjects. Therefore, in general, we do not need to consider the company type (goods producing or service providing) for further analysis. In order to verify and validate the applicability of this finding at a regional level, this paper has compared the goods producing companies of the regional and metropolitan areas in terms of their requirements for graduates' quantitative skills.

A sample of 58 organisations representing both goods producing industries were randomly selected from both regional (Toowoomba) and metropolitan (Ipswich) areas of Queensland in Australia. Data collection was carried out via telephone interviews and a specially designed questionnaire was completed during each call. Hence, the sample size was quite appropriate and manageable for this purpose. The questions aimed to identify the applicability of quantitative Production and Operations Management techniques favoured and utilized by these industries. The major objectives of this study included an investigation of:

- the current status of using different quantitative decision making tools in industries; and
- the employers' needs as addressed by tertiary courses in quantitative subjects.

The following sections present the analysis and discuss the findings of this study.

Analysis and Discussion

It should be noted that there are statistical demographic differences between Toowoomba and Ipswich. These differences, for the purpose of this project, relate to the nature of industries. For instance, compared with Ipswich, Toowoomba is not regarded as an industrial town. The main manufacturing industries in Toowoomba fall into the light to medium category.

(1) Number of people employed

Out of the 58 goods producing companies interviewed, 41 (70.7%) employed less than 30 people (Table 1). However, the number of companies employing less than 10

people was higher in Toowoomba than Ipswich, but employing between 10-30 people was higher in Ipswich than Toowoomba. Coincidently, the numbers of companies employing more than 100 people were the same (13.8%) both in Toowoomba and Ipswich companies. The results of a Chi-Square test has shown that there was no significant difference between Ipswich and Toowoomba companies and the number of people employed (χ^2= 3.11, p-value=0.375)

Table 1: Comparison of Ipswich & Toowoomba companies in terms of number of employees

			Survey Site		Total
			Toowoomba	Ipswich	
Number of people employed	<10	Count	11	8	19
		% within Survey Site	37.9%	27.6%	32.8%
	10-30	Count	8	14	22
		% within Survey Site	27.6%	48.3%	37.9%
	30-100	Count	6	3	9
		% within Survey Site	20.7%	10.3%	15.5%
	>100	Count	4	4	8
		% within Survey Site	13.8%	13.8%	13.8%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=3.110 p-value=0.375

(2) Frequency of Statistical Forecasting Methods (SFM) used for prediction or planning

The majority (53 percent) of the total companies have never used statistical forecasting methods (SFM) for prediction or planning (Table 2). Only around 24 percent of the total companies have adopted SFM 'quite often' and around 22 percent have used them 'sometimes'. The number of companies using SFM 'quite often' was higher in Ipswich (31%) than in Toowoomba (17.2%). On the other hand the number of companies who had 'never used' SFM for planning was higher in Toowoomba (58.6%) than in Ipswich (48.3%). A comparison of the figures has shown some visual difference, however, the Chi-Square test has revealed that there was no significant difference between Ipswich and Toowoomba companies and the frequency of SFM used for prediction or planning (χ^2=1.51, p-value=0.47). A reasonably large p-value would suggest that the null hypothesis of *there is no relationship between the location and the usage frequency* should be accepted in this case.

Table 2: Comparison of Ipswich and Toowoomba companies in terms of frequency of statistical forecasting method (SFM) used for planning

			Survey Site		Total
			Toowoomba	Ipswich	
Frequency of SFM such as regression and	Quite often	Count	5	9	14
		% within Survey Site	17.2%	31.0%	24.1%
	Sometimes	Count	7	6	13

time series used for prediction or planning	Never	% within Survey Site	24.1%	20.7%	22.4%
		Count	17	14	31
		% within Survey Site	58.6%	48.3%	53.4%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=1.510 p-value=0.470

(3) Importance of Systematic Prediction Method (SPM)

On a five scale mapping, it was revealed that the importance of systematic prediction methods (SPM) was 'very low' for around 47 percent of the total companies (Table 3). Approximately 28 percent of the total companies have rated 'moderately high' and another 15.5 percent of the companies either rated 'high' or 'very high'. The number of companies who rated the use of SPM as 'very low' was higher in Toowoomba (51.7%) than in Ipswich (41.4%), which was quite expected. Moreover, the number of companies who rated 'moderately high' was exactly the same for Toowoomba and Ipswich. However, the number of companies who rated the importance as 'high' was higher in Ipswich than in Toowoomba. It should be noted that none of the companies have rated the importance as 'very high' in Ipswich. In the case of Toowoomba, around 7 percent opted for that option ('very high'). Despite these variations, the Chi-Square test has proved that there was no significant difference between the Ipswich and Toowoomba companies in terms of their perception of importance for SPM (χ^2=4.286, p-value=0.369).

Table 3: Comparison of Ipswich and Toowoomba companies in terms of importance of SPM

			Survey Site		Total
			Toowoomba	Ipswich	
Importance of systematic statistical prediction method	Very Low	Count	15	12	27
		% within Survey Site	51.7%	41.4%	46.6%
	Low	Count	2	4	6
		% within Survey Site	6.9%	13.8%	10.3%
	Moderately high	Count	8	8	16
		% within Survey Site	27.6%	27.6%	27.6%
	High	Count	2	5	7
		% within Survey Site	6.9%	17.2%	12.1%
	Very high	Count	2	0	2
		% within Survey Site	6.9%	.0%	3.4%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=4.286 p-value=0.369

(4) Frequency of Mathematical Programming Techniques (MPT) used for resource allocation

Almost 67 percent of the total companies in Ipswich and Toowoomba have 'rarely' used Mathematical Programming Techniques (MPT) for resource allocation (Table 4). Only about 21 percent of the total companies have used MPT 'quite often' for resource allocation. The percentage of the companies who have 'sometimes used' was higher in Ipswich (12.1%) than in Toowoomba (6.9%). Similarly, the percentage of the companies who have 'rarely' used was higher in Ipswich than in Toowoomba. However, the percentage of the companies who have 'quite often' used was exactly the same (20.7%). The Chi-Square test has shown that there was no significant difference between the Ipswich and Toowoomba companies with regard to the frequency of MPT used for resource allocation (χ^2= 1.516, p-value=0.468).

Table 4: Comparison of Ipswich and Toowoomba companies in terms of frequency of mathematical programming technique (MPT) used for resource allocation

			Survey Site		Total
			Toowoomba	Ipswich	
Frequency of MPT such as LP used for resource allocation	Quite often	Count	6	6	12
		% within Survey Site	20.7%	20.7%	20.7%
	Sometimes	Count	2	5	7
		% within Survey Site	6.9%	17.2%	12.1%
	Rare	Count	21	18	39
		% within Survey Site	72.4%	62.1%	67.2%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=1.516 p-value=0.468

(5) Importance of Mathematical Programming Techniques (MPT)

On a five scale mapping of the importance of Mathematical Programming Techniques (MPT), approximately 55.2 percent of the Toowoomba companies have stated either 'very low' or 'low' importance whereas the percentage of the Ipswich companies in these categories was only around 51.7 percent (Table 5). About 31 percent of the Ipswich companies have indicated their perceived importance for MPT as 'moderately high'. This category in the case of the Toowoomba companies received only around 20.7 percent. Around 14 percent of the Ipswich companies have stated 'high' importance for MPT but this category was nil in the case of Toowoomba. It should be noted that the percentage of companies who have the importance of MPT as 'very high' was much higher in Toowoomba (24.1%) than in Ipswich (3.4%). In summary, around 47 percent of companies have stated the importance as 'very low' and around 45 percent as 'moderately high', 'high' or 'very high' importance. In spite of these variations, the Chi-Square test has verified that there was no significant difference between the Ipswich and Toowoomba companies in terms of their perception of the importance of MPT at 95 confidence level (χ^2=9.490, p-value=0.06).

Table 5: Comparison of Ipswich and Toowoomba companies in terms of importance of MPT

			Survey Site		Total
			Toowoomba	Ipswich	
Importance of mathematical programming techniques	Very Low	Count	14	13	27
		% within Survey Site	48.3%	44.8%	46.6%
	Low	Count	2	2	4
		% within Survey Site	6.9%	6.9%	6.9%
	Moderately high	Count	6	9	15
		% within Survey Site	20.7%	31.0%	25.9%
	High	Count	0	4	4
		% within Survey Site	.0%	13.8%	6.9%
	Very high	Count	7	1	8
		% within Survey Site	24.1%	3.4%	13.8%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=9.137 p-value=0.06

(6) Importance of mathematical modeling in decision making

On the five scale rating of importance for mathematical modeling in decision making, around 48 percent of companies in Toowoomba and 41 percent in Ipswich have rated 'very low' (Table 6). Around 7 percent of companies in Toowoomba stated 'very high' whereas there was no company stating 'very high' among the Ipswich companies. In summary, around 57 of the total companies have rated the importance of mathematical modeling in general as either 'low' or 'very low' and only around 19 percent either 'high' or 'very high' importance. The Chi-Square test has demonstrated that there was no significant difference between the Ipswich and Toowoomba companies with regard to their perception of the importance of mathematical modeling in decision making (χ^2=3.551, p-value=0.47).

Table 6: Comparison of Ipswich and Toowoomba companies in terms of importance of mathematical modeling in decision making

			Survey Site		Total
			Toowoomba	Ipswich	
Importance of mathematical modeling in decision making in your organization	Very Low	Count	14	12	26
		% within Survey Site	48.3%	41.4%	44.8%
	Low	Count	4	3	7
		% within Survey Site	13.8%	10.3%	12.1%
	Moderately high	Count	5	9	14
		% within Survey Site	17.2%	31.0%	24.1%
	High	Count	4	5	9
		% within Survey Site	13.8%	17.2%	15.5%
	Very high	Count	2	0	2

	% within Survey Site	6.9%	.0%	3.4%
Total	Count	29	29	58
	% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=3.551 p-value=0.47

(7) Comparison of types of company in terms of perception on skill of university graduates

It was quite interesting to note that the perceived figures in both cases of the regional and metropolitan industries in terms of the suitability of graduates to undertake the tasks were identical (50-50 percent) (Table 7). Surprisingly, the majority of the companies in Ipswich (58.6) perceived that the university graduates were not in possession of suitable skills to undertake the assigned tasks. The same percentage of the Toowoomba companies (58.6%) felt that university graduates had the relevant skills. The Chi-Square test has shown that there was no statistically significant difference between the Ipswich and Toowoomba industries with regard to their perception of the university graduates' skills (χ^2=1.724, p-value=0.19).

Table 7: Comparison of Ipswich and Toowoomba companies and in terms of perception on skill of university graduates

			Survey Site		Total
			Toowoomba	Ipswich	
University graduates possess suitable skills to undertake the tasks	Yes	Count	17	12	29
		% within Survey Site	58.6%	41.4%	50.0%
	No	Count	12	17	29
		% within Survey Site	41.4%	58.6%	50.0%
Total		Count	29	29	58
		% within Survey Site	100.0%	100.0%	100.0%

Chi-Square=1.724 p-value=0.19

Conclusions

A close analysis of the data has demonstrated that there was no statistically significant difference between the Toowoomba and Ipswich companies in all tested parameters. The conclusion of the analysis was that regardless of the geographical position (regional or metropolitan) the current status of using quantitative decision making tools in different industries is the same. The employers' perception on skills of university graduates was found to be very similar as a significant percentage (50%) has claimed that the graduates did not have the necessary skill to undertake their task In other words, the companies appear to have a common practice and thinking towards their needs and tertiary courses in quantitative subjects. Hence, regarding the needs of companies and skills of university graduates a significant gap has been identified, which needs to be addressed.

From theoretical and practical perspectives, it is not always possible to prepare courses and produce graduates who would fully satisfy the needs of every industry. However, since a significant percentage (50%) of the companies has indicated that the graduates did not have skill to undertake their task; tertiary institutes should consider adjusting their courses in line with the needs of industries. For this to be possible, a sound collaboration and co-working between the graduates' producers and graduate

demanders could be highly productive. Hence, this project has also paved the way for further work in identifying effective methods of teaching quantitative topics to Business students. Future work will include state and nation-wide studies. Finally, it should be noted that similar studies in other parts of the world would certainly contribute to the body of knowledge and possible plans of action in this area.

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