Research Report

Asia-Pacific Journal of Cooperative Education

Science and Technology Stakeholders' Ranking of Graduate Competencies Part 4: Faculty Perspective †

Karsten E. Zegwaard*
Cooperative Education Unit, School of Science and Technology, University of Waikato, Private Bag 3105, Hamilton, New Zealand

and

Dave Hodges
Faculty of Business, UNITEC Institute of Technology, Private Bag, 92025 Auckland, New Zealand.

Received 11 August 2003; accepted 23 October 2003

This paper presents the final part of an investigation into science and technology graduate competencies in the workplace as viewed by the major stakeholders. Here we report the views held by science and technology faculty members and make comparisons to views held by the other stakeholders in science and technology and the views of business faculty members. The study suggests that science and technology faculty members' views share similarities to those of employers, recent graduates, students and business faculty, however, it also display views unique to both faculty and the science and technology sector. It appears that science and technology faculty have some strong views on what they perceive to be important, and these views may have influenced the views of students and graduates completing further studies. (*Asia-Pacific Journal of Cooperative Education, 2003, 4(2), 36-48).*

Keywords: New Zealand; faculty; ranking; competencies; science; technology; hard skills; soft skills; technical skills

This paper reports on science and technology faculty perceptions of specific work place competencies. Recent work revealed differences in perceptions of the importance of certain desirable graduate competencies for science and technology students and their employers (Coll, Zegwaard & Hodges, 2002a, 2002b), recent graduates (Zegwaard & Hodges, 2003) and business counterparts (Burchell, Hodges & Rainsbury, 2001). The aim of the present study was to complete an overview of the perceptions held by all the major stakeholders in science and technology; employers, students, recent graduates and in the case of this work faculty members, to determine if there were differences in perceptions among these science and technology stakeholders. The present work also aimed to contribute to the literature by enabling comparison with similar studies carried out on major stakeholders of other sectors such as the business sector. This present study was deemed of particular interest in that the authors wanted to see if views of workplace competencies of science and technology faculty differed from the views of science and technology students and graduates. In addition, we wished to see if any difference in views existed between business faculty members (of business graduate competencies) and those of science and technology faculty (of science and technology graduate competencies).

Theoretical Basis of the Study

The theoretical basis of this four part study and the instrument used is that described in detail in previous work

† Part 1, *Asia-Pacific Journal of Cooperative Education, (2002), 3(2), 19-28*; Part 2, *Asia-Pacific Journal of Cooperative Education, (2002), 3(2), 35-44*; Part 3, *Asia-Pacific Journal of Cooperative Education, (2003), 4(2), 23-35*

Correspondence: Karsten Zegwaard, email: k.zegwaard@waikato.ac.nz

(see Coll, Zegwaard & Hodges, 2002a, 2002b; Zegwaard & Hodges, 2003), which was in turn based on similar studies of business counterparts including employers, students, recent graduates and academics (Burchell, Hodges & Rainsbury, 2001). The theoretical basis used for this study is briefly described below.

Competency can be viewed as a characteristic of an individual (Boyatzis, 1982) that is causally related to job performance (Spencer & Spencer, 1993). Competencies can also be seen as representing a capacity to perform at some future point (Boam & Sparrow, 1992; Page, Wilson & Kolb, 1993). There is some interchange and contrasting views of like terms such as competency and capability in the literature. For example, Stephenson (1997) sees capability as the integration of knowledge, skills, personal qualities and the ability to learn, to deal effectively with unfamiliar and familiar situations or tasks: a view similar to that which Birkett (1993) terms competency. Stephenson states (p. 9-10): "Competence delivers the present based on the past, while capability imagines the future and helps to bring it about...competence is about dealing with familiar problems in familiar situations." Conversely, Rudman (1995) views capability as a precursor to competency, where an individual has the capability to perform a specific task because they have the necessary knowledge and skills, but they do not become fully competent in the task until they have had some experience. In other words, competency is intrinsically linked to context.

While the graduate competencies used in this study were based primarily on the work of Spencer and Spencer (1993), the study was also influenced by the taxonomy presented by Birkett (1993), which viewed competency as the interaction of cognitive (or hard) skills and behavioral (or soft) skills. Cognitive, or 'hard' skills (Page, Wilson & Kolb, 1993), comprise technical skills, analytical skills and appreciative skills. Behavioral skills, or 'soft' skills, comprise personal skills (such as how one responds and handles various situations), interpersonal skills (such as securing outcomes through interpersonal relationships), and organizational skills (securing outcomes through organizational networks) (Caudron, 1999; Kemper, 1999; McMurchie, 1998). For both cognitive and behavioral skills, the skills may be ordered according to increasing complexity, and be considered to be cumulative in that the skills build upon each other. For example, if an individual applies technical skills well, the next level might then be to develop analytical and problem-solving skills. Any successful or competent individual will likely hold a combination of cognitive and behavioral skills (Birkett, 1993).

Many authors now see that hard and soft skills are complementary (Spencer & Spencer, 1993) and Hackett, Betz and Doty (1985) identified a number of skills that sub-serve the broader function of soft skills. These include things such as the ability to communicate well, to relate effectively to others, to plan and manage the demands of one's job, to exercise leadership, and to cope with stress effectively. There is a view that employers commonly neglect the development of soft skills because of the difficulty in their measurement, or difficulty in demonstrating a link between them and desired work outcomes. Furthermore, soft skills are seen by some to be more difficult to develop than hard or technical skills (Arnold & Davey, 1994; Caudron, 1999; Georges, 1996).

The work reported here also was informed by sociocultural views of learning (Wertsch, 1991). We wish here to develop an understanding of perceptions of desirable graduate competencies for science and technology faculty members. Sociocultural views of learning suggest that past research has not paid enough attention to the social mediation of mental construction such as individuals' perceptions and beliefs. Wertsch (1991) summarizes the basis of a sociocultural approach as one in which learning is seen as "inherently situated in social interactional, cultural, institutional, and historical context. Such a tenet contrasts with approaches that assume, implicitly or explicitly, that it is possible to examine mental processes such as thinking or memory independently of the sociocultural setting in which individuals and groups function" (p. 86).

In the context of this study, sociocultural views of learning suggests that learning is conveyed by the setting, the institutional framework in which the encounter takes place, the participants' dialogue and attitudes, their sense of social identity the objects manipulated and the type of interpersonal relationship established. One might expect that faculty views of desirable graduate competencies be influenced by their experiences, and possibly have imparted these views onto students and, particularly, post-graduate students within the department, hence, some similarity may exist between these groups.

Methodology

Background for the Study

The authors see co-op as a means to develop individual's specific competencies and skills (Coll, Zegwaard, & Hodges, 2002a, 2002b; Zegwaard & Hodges, 2003). According to Spencer and Spencer (1993) a number of generic competency categories account for 80% to 95% of the distinguishing features of superior performers in technical and managerial positions. These are the competencies investigated here and they were classified into cognitive skills and behavioral skills (or hard and soft skills, respectively) utilizing Birkett's (1993) taxonomy.

Research Objectives

The overall aim for this study is to complement research carried out on science and technology employers (Coll, Zegwaard & Hodges, 2002a), students (Coll, Zegwaard, & Hodges, 2002b) and recent graduates (Zegwaard & Hodges, 2003) as well as that of a similar study carried out on business sector employers (Burchell, Hodges & Rainsbury, 2001). We thus sought to identify science and technology faculty views of the importance of specific graduate competencies required in the work place. Based on the literature definitions of competency, the research utilized a theoretical framework derived from the notion of competency, specifically the competencies identified by Spencer and Spencer (1993), with four additions; ability and

willingness to learn; written communication; personal planning and organizational skills; and computer literacy, made by Meade and Andrews (1995) and Sweeney and Twomey (1997).

Survey Instrument

The generic competencies used in the study are provided in Appendix A. The survey instrument that was used is that used by Burchell, Hodges and Rainsbury (2001), Coll, Zegwaard and Hodges (2002a, 2002b), Rainsbury, Hodges, Burchell and Lay (2002) and Zegwaard and Hodges (2003) (Appendix B).

The participating faculty were asked to rate the importance of each competency (from a total list of 24) using a 7-point Likert scale (1 = unimportant to 7 = important). The competencies were listed in random order and faculty were asked to rate the importance of each competency as they viewed its importance for graduates entering the workplace today and what they perceive the importance would be for graduates entering the workplace in 10 years time (the latter was added to allow participants to indicate if they perceive any competencies to change in importance in the future). Participants also were able to provide written comments on the survey form, and to add any additional competencies they deemed important. The survey form also contained definitions for each of the 24 competencies listed.

Context of the Study

The University of Waikato has around 14,000 equivalent full-time students (EFTS), of which around 1000 equivalent full-time enrolments are in the School of Science and Technology. The school offers three undergraduate degrees; Bachelor of Science (BSc), Bachelor of Science (Technology) (BSc(Tech)), and Bachelor of Engineering (BE), of which the later two are cooperative education degrees. The BSc is a standard three-year science degree, while the BSc(Tech) is a four-year science degree which includes 12 months of relevant work experience (Kirk & Chapman, 1992). The BE (which recently subsumed the earlier reported Bachelor of Technology - BTech) is a four-year engineering focused degree, has six months of relevant work experience (Coll, 1996). It has around 50 enrolments, with indications of promising growth. Currently 60% of undergraduate students are enrolled in a cooperative education degree. The Cooperative Education Unit, a team of academic staff who hold joint appointments between the subject discipline and the Unit, facilitates about 170 student placements in a given year (Coll & Eames, 2000). The school also offers graduate degrees; the Masters of Science (MSc), Masters of Science (Technology) (MSc(Tech)) – which differs from the MSc degree by having a greater emphasis on technology and its application - the Doctor of Philosophy (PhD), and recently introduced the Masters of Engineering (ME), with currently around 200 equivalent full-time enrolments in these graduate degrees.

UNITEC has around 10,000 EFTS. Faculty surveyed come from three schools; the School of Health Sciences (26 full and part-time staff teaching approximately 260 EFTS), the School of Engineering (21 full and part-time staff teaching approximately 200 EFTS), and the School of Animal Health and Welfare (11 full and part-time staff teaching approximately 160 EFTS). The three schools offer four undergraduate degrees; Bachelor of Health Science (Medical Imaging), Bachelor of Applied Science (Human Biology), Bachelor of Engineering Technology, and a Bachelor of Engineering (Environmental). Degrees at postgraduate level include the Master of Health Science (Medical Radiation Technology) and a Master of Osteopathy. The School of Animal Health and Welfare does not currently offer a degree programme, although has recently developed a Bachelor of Applied Animal Technology that will be introduced in 2004. All the undergraduate degrees require students to complete a cooperative education component, except the Bachelor of Applied Science (Human Biology), with time spent in the work place ranging from 800 hours in the two engineering degrees to 2,500 hours spread over three years in the Bachelor of Health Science (Medical Imaging).

Sample Demographics

Academic faculty members were drawn from two institutes; the University of Waikato, Hamilton, and UNITEC Institute of Technology, Auckland (76 & 24% of respondents, respectively). At the University of Waikato faculty members were drawn from the School of Science and Technology and the School of Computing and Mathematical Sciences. These two schools offer undergraduate and graduate degrees in science (such as biology, chemistry, the Earth sciences, and computer sciences), technology, mechanical and process engineering, mathematics and statistics. At UNITEC members were drawn from the School of Health Sciences, School of Engineering and the School of Animal Health and Welfare, which cover the areas of environmental and technical engineering, medical sciences, veterinary nursing and animal technology. At each of the institutes the faculty members held higher degrees - the majority held PhDs - and were extensively involved in teaching of undergraduate degrees, including some co-op degrees.

Instrument Administration

The survey was distributed to faculty members using a personalized letter sent via the internal mail system. The mail-out was repeated six weeks later to those that had not responded (a confidential administrational numbering system was used to eliminate those that had responded to the first mail-out), which increased the response rate by a third. A third mail-out was considered but deemed not effective, as the response rate at this stage was satisfactory (Cohen, Manion & Morrison, 2000). The total number of faculty members surveyed at Waikato was 116, of which 54 responded (47% response rate), and a total of 58 at UNITEC, of which 18 responded (33% response rate). This gave an overall response rate of 41% (n=72), which is considerably higher than many other reported survey response rates, and may reflect a professional and personal

interest faculty have in graduate competencies in the workplace, and established relationships with the researchers who carried out the research.

Data Analysis

Estimated mean values were calculated for all of the competencies, and in addition competencies were categorized into hard and soft skills – according to Birkett's (1993) taxonomy. The term estimated mean is used here as this data is ordinal level (i.e., non-continuous, such as Likert scale, rather than continuous data such as age, or weight), hence, means are estimated and can only be used to show the ranking of the data. The estimated means were examined for statistically significant differences using conventional statistical methods. Test for statistical significance for any differences observed were carried out between perceptions for today and for 10 years time, and separate analyses were carried out to investigate for any differences based on institute of origin. The estimated importance for hard and soft skills were determined by summing the means of all competencies within each category, respectively and dividing by the number of competencies in each category.

Results and Discussion

Faculty Rating of Desirable Competencies - Today

The estimated means for the competencies ranged from 4.43 to 6.61. Rainsbury, Hodges, Burchell and Lay (2002), Coll, Zegwaard and Hodges (2002a, 2002b) and Zegwaard and Hodges (2003) interpreted an estimated mean of less than 4 to indicate that the respondents viewed this as unimportant. None of the competencies were rated below 4 and on this basis the present work shows that faculty members view all competencies as important. This was supported with comments made by several respondents, "Anyone who scored well in all these traits would get a job in any century" and, "I can think of numerous instances where every item listed deserves a 7, i.e., all of those items listed are essential" and, "employers want a graduate who is a good all rounder as well as an expert" and, "broad knowledge base besides just science".

The 10 top ranked competencies by faculty members were *ability and willingness to learn*; *written communication*, *analytical thinking*, *computer literacy*, *team work and cooperation*, *technical expertise*; *concern for order*, *quality and accuracy*, *initiative*, *information seeking*, and *personal planning* (Table 1 & Figure 1).

An interesting finding is that faculty viewed *ability and willingness to learn* to be the most important competency, a view that has was held consistently by all major science and technology stakeholders - employers, students and recent graduates - and also business faculty members (Burchell, Hodges & Rainsbury, 2001). Like the other stakeholders, science and technology faculty members' perceptions were strong in this view, and they made comments that state that it was important that graduates "develop skills in life-long learning" and are "prepared to listen and learn" and have the "ability to learn independently". These views are much as those of researchers, who have long held the view that lifelong learning is essential (Gow & McDonald, 2000) when participation in work environments that are continually changing, where change should be tolerated (Gow, 1995), seen as an opportunity (Hines, 1993), and allow the development of new tasks (Cordery, Sevastos, Mueller & Parker, 1993).

Written communication was rated second highest by faculty, a view that was different to science and technology students, employers and recent graduates, and business faculty. Science and technology faculty were strongly of the view that *written communication* was an important competency for graduates entering the workplace, and made comments suggesting that they felt their students writting skills are relatively weak.

> I think written communication could be a key issue - it is important now, but as computer usage increases there is a key danger that literacy skills may generally decrease.
>
> Graduates needs better appreciation of the importance of correct grammar, punctuation and spelling in written communication. My present students are poor at attention at this detail. Are email and text messaging to blame? Is the primary and secondary school system to blame? At the risk of sounding old before my time, what has happened to reading, writing and arithmetic?

Coll, Zegwaard and Hodges (2002b) and Zegwaard and Hodges (2003) found that students and recent graduates did not value *written communication* highly and thought that the importance of this competency would decrease in the future. Some comments made by students and recent graduates suggest that they believe advancements in technology will lessen the need for written skills. It is important to note that the BSc(Tech) students must undertake two management courses, typically the two prescribed courses for the degree, which cover the areas of communication in greater detail (University of Waikato, 2003). These two courses were developed in response to employer and faculty feedback and, since the development of this course, the communication section has been expanded further (Chapman, 1994; Kirk & Chapman, 1992). However, non-co-op students are not expected to undertake this course and possibly to address the issue of communication it may be valuable to extend this requirement to all undergraduate students. Interestingly, Zegwaard and Hodges (2003) found that recent graduates who continued on to carry out graduate studies (such as masters degrees or post-graduate diplomas) valued *written communication* highly. That view is probably influenced by the fact these recent graduates would have been completing dissertations and theses (which have demanding written components) and viewed this to be the norm in the workplace. It might also reflect that at this level of study, post-graduate students have a greater interaction with faculty members, possible allowing faculty members to impart their views on these graduates, to the extent that

Table 1
Science and technology faculty rating of workplace competencies (estimated means based on a 7 point Likert scale where 1 = unimportant and 7 = important, n=72)

	Today			10 Year's Time	
Soft Skills	Mean	Std. Deviation	Std. Error	Mean	Std. Deviation
Team work and cooperation	5.85	1.079	0.134	6.16	1.011
Flexibility	5.58	1.044	0.130	6.05	0.933
Relationship building	5.51	1.077	0.134	5.69	1.111
Organizational awareness	4.68	1.288	0.160	4.94	1.283
Concern for order, quality and accuracy	5.80	1.202	0.149	6.02	1.031
Impact and influence on others	4.85	1.202	0.149	4.97	1.195
Initiative	5.78	1.166	0.145	5.95	1.119
Customer service orientation	5.02	1.474	0.183	5.41	1.281
Developing others	4.69	1.489	0.185	4.91	1.466
Directiveness	4.44	1.360	0.174	4.52	1.479
Team leadership	4.88	1.364	0.169	5.09	1.498
Self control	5.35	1.363	0.169	5.48	1.247
Organizational commitment	4.77	1.306	0.163	4.72	1.474
Ability and willingness to learn	6.17	0.993	0.123	6.39	0.919
Interpersonal understanding	5.25	1.186	0.147	5.39	1.203
Self confidence	5.42	1.088	0.135	5.66	1.057
Information seeking	5.72	0.960	0.119	6.00	0.926
Achievement orientation	5.52	1.348	0.167	5.86	1.367
Hard Skills					
Computer literacy	5.89	1.033	0.128	6.41	1.019
Conceptual thinking	5.62	1.128	0.140	5.95	1.015
Technical expertise	5.83	1.106	0.138	5.95	1.240
Analytical thinking	6.00	0.926	0.116	6.22	0.888
Personal planning and organizational skills	5.68	1.105	0.137	5.98	1.016
Written communication	6.09	0.897	0.111	6.05	1.075

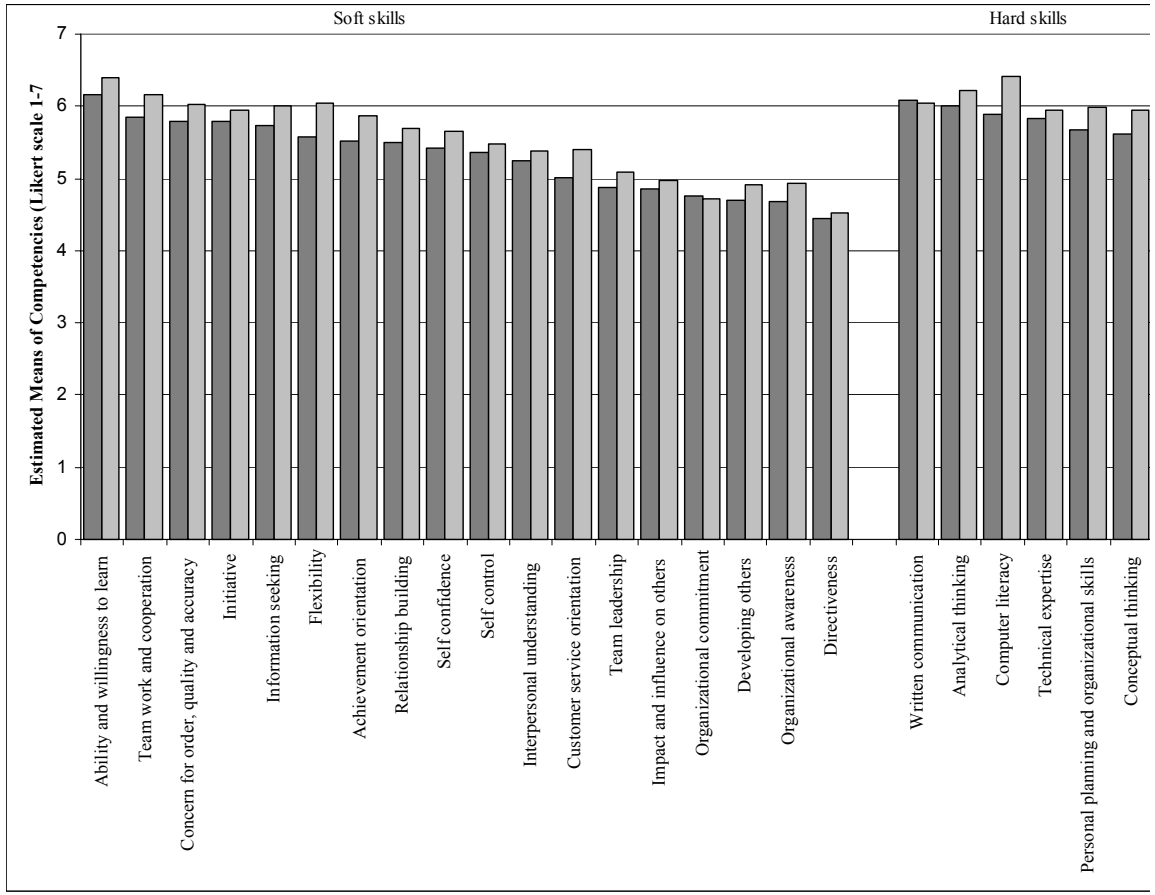

Figure 1
Faculty rating of workplace competencies for science and technology graduates entering the workforce today (dark grey) and in 10 years time (light grey) (n=72)

some enculturation into the tertiary education institute is taking place.

The high ranking of *analytical thinking*, *computer literacy*, *technical expertise*, *concern for order*, *quality and accuracy*, and *information seeking* is perhaps a reflection of competencies that science and technology particularly draws upon. These competencies are typically required to a high standard in applied science and research of science and, therefore, it is not surprising that science and technology faculty rate these relatively highly compared to other competencies.

These views of science and technology faculty contrast with business faculty views. In a similar survey of business faculty, Burchell, Hodges and Rainsbury (2001) found that the more technical competencies were considered to have relatively less importance by business faculty.

Technical expertise, concern for order quality and accuracy, and *information seeking* did not feature in the top competencies by business faculty. This perhaps emphasizes key differences in the needs of these two disciplines.

Some science and technology faculty thought that having a university qualification was important and graduates should take comfort in their qualification.

> Our New Zealand graduates need first an excellent background in basic science, and confidence from university lecturers and administration that New Zealand education is equivalent/better than any place else on the globe.

It is worthy of note that one faculty member went to the extent of suggesting that the acquirement of a university degree as an extra competency, quoting it as 4 on the Likert scale for today, but 7 in importance in 10 years time. Another faculty member made a comment that suggested that graduates with bachelors degrees will be expected to learn the above competencies in the workplace as well as having acquired them at university, and went on to suggest that those who graduated with post-graduate degrees would be expected to be more highly competent when entering the workplace.

Faculty Rating of Desirable Competencies – Ten Years Time

Faculty perceived all competencies to increase in importance in 10 years time, except for *written communication* and *organizational commitment*. Interestingly, faculty views of the relative ranking of importance of the competencies were similar for 10 years time, with only *flexibility* changing in ranking by five or more places in 10 years time (from 12 to 5). The highest rated competency in perceived importance in 10 years time was *computer literacy*, where it was originally ranked at fourth for today's perceived importance, and shows the biggest increase in importance (0.51, statistically significant, $p<0.1$). Faculty held strong views that *computer literacy* will increase in its use in the workplace and that employers will expect new graduates to be fully competent in this area. One faculty member commented: "Computer skills like GIS [i.e., Global Information Systems] will be an expectation - like Microsoft Word is now - by employers of our graduates", whilst another commented "better computer skills will be required in [the] future. Computer skills will have to increase."

Ability and willingness to learn ranked second highest in perceived importance by faculty in 10 years time, and appear to linked that perception with that of a perceived increase in importance of *computer literacy*. Faculty perceived that change will become rapid in the workplace and that graduates need to be able to adapt and learn quickly in these situations. The main catalyst for change was perceived to be technology.

> [It] is important for us [to have the] ability to change and learn new technologies

> Employers want a graduate, as I interpret … [who] has a wide range of knowledge, including in the emerging technologies [and who] must be prepared to quickly come up to speed and be able to take on new issues.

> I think change will be faster in 10 years time, ability to learn independently will be more necessary and that computer programming will be more technically demanding

Faculty believed that technology, and the ability to adapt to new technology, will have a major part in future workplaces, a view shared with recent science and technology graduates, employers and students, as well as business faculty. Recent graduates hold this view rather strongly, however, one faculty member gave a warning that we should not rely on technology to solve everything for us, commenting that graduates "must be able to *think* [original emphasis] in the future despite technology and software being available"

Flexibility was a competency that also showed a statistically significant increase in perceived importance from today to 10 years time (increase in estimated mean of 0.46, statistically significant, $p <0.1$). This may, in part, be related to the perceived high importance in the future of technology and the ability to learn new task. The advancement of technology is perceived to result in more rapid change in the future, therefore, increasing the perceived importance of *ability and willingness to learn* and *ability to adapt and change*, and, hence, the need for *flexibility*.

Interestingly, *customer service orientation* showed the third largest increase in perceived importance (increase in estimated mean by 0.39) although this was not statistically significant. Faculty perceived that the science and technology sector would have a greater customer focus in 10 years time. This view of increasing customer service focus in 10 years time was shared by science and technology employers (Coll, Zegwaard & Hodges, 2002a), who also perceived a greater role of customer service orientation in 10 years time. A comment by a faculty member linked flexibility and customer service orientation together: "As we become increasingly customer focused, employers will expect flexibility in order to serve their customer needs".

It was interesting to note that *written communication* was

not perceived to increase in importance in 10 years time, given the high ranking of perceived importance for today and the numerous comments regarding the poor performance of students' written skills. In part this can be explained by the fact that *written communication* already ranked very highly compared with other competencies (ranked second for importance today), although it does not fully explain why this failed to increase in importance when other high ranking competencies did.

Comparison of Hard and Soft Skills

Faculty rated both soft and hard skills as important (i.e., estimated means greater than 4), however, overall they viewed that hard skills to be more important than soft skills (overall estimated mean of 5.85 & 5.29 for hard and soft skills respectively, statistically significant, $p<0.1$). Hence it seems, despite both soft and hard skills being rated as important, faculty consider hard skills to be more important than soft skills. Typically science draws heavily upon hard skills, such as *written communication*, *analytical thinking*, *computer literacy*, and *technical expertise*, which faculty traditionally see as their main role to teach and often are perceived easier to assess than soft skills (Rubin, 1985; Schon, 1983, 1987). It is, therefore, perhaps not surprising that faculty see hard skills as important and all hard skills were ranked within the top 10 competencies by faculty. This contrasts with business faculty views, where only two of the six competencies categorized as hard skills, were ranked in the top 10 (namely, *computer literacy* and *analytical thinking*). It is interesting to note here that despite hard skills being perceived overall more highly than soft skills, science and technology faculty had strong views about some soft skills, which they see as essential for graduates entering the work place, particularly *ability and willingness to learn* (ranked highest), *team work and cooperation*, *concern for order, quality and accuracy*, *initiative*, and *information seeking*, ranked fifth, seventh, eighth, and ninth, respectively.

Enculturation and Workplace Changes

Faculty showed evidence, by virtue of their written comments, that they viewed it to be important for graduates to be accepted and enculturated into the workplace, a view also held by recent graduates (Zegwaard & Hodges, 2003). Faculty made numerous comments suggesting that, additional to the listed competencies, it was important to be focused on team work and behavioral skills. Some of these suggested additional 'competencies' were; 'common sense', 'seeing the larger picture', 'political awareness' (something recent graduates also made mention of), 'ability to work with different gender and ethnic groups'. One faculty member remarked that in the future workplace teams will be more interdisciplinary and that it will be important to stay in touch with what is happening around the team. Another faculty member made an interesting comment, where, in his (or her) view, there were three over-riding competencies, which focused on respected behavior within a workplace. In the view of this respondent these were more important than the competencies listed in the survey: "Professional ethics, integrity and honesty. I believe the three I have added to be, individually, more important than all the other put together!"

Faculty also noticed that it is the norm to change organizations during one's career and show this by the low ranking of *organizational commitment* (estimated mean of 4.77, ranked 21st) for perceived importance today. This, they suggest, is now common practice by employees and that it has the undesirable effect of the loss of knowledge and capability to the organization. Given the transient/short term nature of some, maybe many, positions *organizational commitment* may not rule too highly:

> The level of commitment by organizations has been very low over the last decade due to the market driven model. People have recognized this and are themselves now opportunists. Employers [are] starting to see the loss of intellectual capital and there are signs of a move away from a 'slave driven' mentality.
>
> The term 'organization commitment' is, I regret to say, ambiguous in the sense that there is usually both an 'official' form and a 'personal' form – rarely do the two agree!

Faculty rated *organizational commitment* slightly lower in perceived importance for 10 years time (estimated mean of 4.72; ranked 23rd). Therefore, it is seen that faculty do not envision that the problem of 'transient career changes' will improve in the future - rather that it will worsen.

Conclusions

The research findings reported here suggest that science and technology faculty value both hard and soft skills, and perceive all competencies to be important for graduates entering the workplace. Faculty perceive that employers want graduates that are well rounded and that all competencies are essential and sought after.

Despite both soft and hard skills being ranked as important, science and technology faculty perceive hard skills to be significantly more important than soft skills (estimated means of 5.85 & 5.29, respectively, statistically significant, $p<0.1$). The competency ability and willingness to learn was ranked the highest, a view consistent with views held by science and technology employers, students and recent graduates (Coll, Zegwaard & Hodges, 2002a, 2002b; Zegwaard & Hodges, 2003) and business sector faculty (Burchell, Hodges & Rainsbury, 2001).

The need for enculturation into the workplace was identified by science and technology faculty, and they viewed it as important that graduates entering the workplace have professional behavior and integrity.

Faculty perceive that all competencies for graduates entering the workplace will become more important in 10 years time, with the exception of *written communication* and *organizational commitment*. The biggest increases in perceived importance in 10 years time were for *computer literacy*, *flexibility* and *customer service orientation*. It

appears that faculty perceive the increases in importance of *ability and willingness to learn*, *computer literacy* and *flexibility* to be linked and related to the rapid changes of technology in the workplace, therefore, making the ability to change, adapt and learn new skills in the work place as vital.

Interestingly, faculty viewed *organizational commitment* as less important than other competencies and rated its perceived importance even lower for 10 years time. This appears to be a response to the view that, despite the detrimental effects, it is a norm to change organizations for the duration of ones career - a view also held by science and technology recent graduates.

Faculty valued *written communication* highly and perceive this to be an important competency for graduates entering the workplace. Furthermore, faculty expressed concern that students appear to have poor written communication skills. Past research has shown that science and technology students and recent graduates do not share the same perception about written communication as faculty members (Coll, Zegwaard & Hodges, 2002b; Zegwaard & Hodges, 2003). However, faculty may have imparted their views onto graduates who continue with further studies, as they also valued *written communication* highly. The value of the compulsory management courses for undergraduate co-op students, which covers *written communication*, was highlighted, and it was suggested it would be valuable for all undergraduate students to complete this course.

The perceptions that science and technology faculty have of graduate competencies were interesting for co-op practitioners in that knowledge of these views helps practitioners' understanding of faculty perceptions. This highlights differences in perceptions held by key stakeholders in science and technology and differences in views from other sectors such as the business. Such knowledge may be of benefit to the further development of cooperative education programs.

Acknowledgements

The authors would like to gratefully acknowledge Mark Lay of the Department of Materials and Process engineering at the University of Waikato for suggesting the research topic. We also acknowledge Dr Richard K. Coll, of the University of Waikato, for his helpful advice, expertise and support with this research and the writing of this article.

References

Arnold, J., & Davey, K.M. (1994). Evaluating graduate development: Key findings from the graduate development project. *Leadership and Organization Development Journal*, *15*(8), 9-15.

Boam, R., & Sparrow, P. (1992). *Designing and achieving competency*. London: McGraw-Hill.

Boyatzis, R.E. (1982). *The competent manager*: *A model for effective performance*. New York: Wiley.

Birkett, W.P. (1993). *Competency based standards for professional accountants in Australia and New Zealand*. Melbourne, Australia: Australian Society of Certified Practising Accountants.

Burchell, N., Hodges, D., & Rainsbury, E. (2001). What competencies do business graduates require? Perspectives of New Zealand stakeholders. *Journal of Cooperative Education*, *35*(2-3), 11-20.

Caudron, S. (1999). The hard case for soft skills. *Workforce*, *78*(7), 60-64.

Chapman, R. (1994) Cooperative education in science and technology: BSc(Tech) the degree that works. In C. Eames (Ed.), *Proceedings of the Asia-Pacific Conference on Cooperative Education* (pp. 48-51). Auckland, New Zealand

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London: Routledge-Falmer.

Coll, R.K. (1996). The BSc(Technology) degree: Responding to the challenges of the education marketplace. *Journal of Cooperative Education*, *32*(1), 39-45.

Coll, R.K., & Eames, C. (2000). The role of the placement coordinator: An alternative model. *Asia-Pacific Journal of Cooperative Education*, *1*(1), 9-14.

Coll, R.K., Zegwaard, K., & Hodges, D. (2002a). Science and technology stakeholders' ranking of graduate competencies Part 1: Employer perspective. *Asia-Pacific Journal of Cooperative Education*, *3*(2), 19-28.

Coll, R.K., Zegwaard, K., & Hodges, D. (2002b). Science and technology stakeholders' ranking of graduate competencies Part 2: Student perspective. *Asia-Pacific Journal of Cooperative Education*, *3*(2), 35-44.

Cordery, J., Sevastos, P., Mueller, W., & Parker, S. (1993) Correlates of employee attitudes towards functional flexibility. *Human Relations, 46*, 705-707

Georges, J.C. (1996). The myth of soft skills training. *Training*, *33*(1), 48.

Gow, K.M. (1995). In and out: Entry-level competencies for school leavers and university graduates. *Australian Training Review*, *Sept/Oct/Nov*, 15-16.

Gow, K.M., & McDonald, P. (2000). Attributes required of graduates for the future workplace. *Journal of Vocational Education and Training*, *52*(3), 373-394.

Hackett, G., Betz, N.E., & Doty, M.S. (1985). The development of a taxonomy of career competencies for professional women. *Sex Roles*, (12), 393-409.

Hines, A. (1993). Transferable skills will land you a job in the future. *HR Magazine*, *38*(4), 55-56

Kemper, C.L. (1999). EQ vs. IQ. *Communication World*, *16*(9), 15-19.

Kirk, C.M., & Chapman, R. (1992). Science and technology management: Designing an undergraduate course. *Research in Science Education*, *22*, 252-259.

McMurchie, L.L. (1998). Careers can rise or fall with EQ. *Computing Canada*, *1*(9), 18-21.

Meade, P., & Andrews, R. (1995). Measuring employer satisfaction in higher education. *The Quality Magazine, April*, 52-53.

Page, C., Wilson, M., & Kolb, D. (1993). *Managerial competencies and New Zealand managers: On the inside, looking in*. Auckland, New Zealand: University of Auckland.

Rainsbury, E., Hodges, D., Burchell, N., & Lay, M. (2002). Ranking workplace competencies: Student and

graduate perceptions. *Asia-Pacific Journal of Cooperative Education*, *3*(2), 8-18.

Rubin, L. (1985). *Artistry in teaching.* New York. Random House.

Rudman, R. (1995, July). *Competencies and capabilities for effective human resource management*. Paper presented at the 22nd annual conference of the Asian Regional Training and Development Organization. Melbourne, Australia.

Schon, D.A. (1983). *The reflective practitioner*. New York. Basic Books.

Schon, D.A. (1987). *Educating the reflective practitioner.* San Francisco. Jossey-Bass.

Stephenson, J. (1997). *Capability: Educating for life and work*. Wellington, New Zealand: Education and Training Support Agency

Spencer, L.M., & Spencer, S.M. (1993). *Competence at work*. New York: Wiley.

Sweeney, M., & Twomey, P. (1997, Aug.). *Preparing graduates for 2020: The role of cooperative education*. Paper presented at the 10th World Conference on Cooperative Education. Cape Town, South Africa.

University of Waikato (2003). *Calendar*. Hamilton, New Zealand.

Wertsch, J.V. (1991). A sociocultural approach to socially shared cognition. In L.B. Resnick, J.M. Levine, & S.D. Teasly (Eds.), *Perspectives on socially shared cognition* (pp. 85-100). Washington, DC: American Psychological Association.

Zegwaard, K.E., & Hodges, D. (2003) Science and technology stakeholders' ranking of graduate competencies Part 3: Graduate perspective. *Asia-Pacific Journal of Cooperative Education*, *4*(2), 23-35.

Appendix A

Generic competencies that account for 80-95% of the distinguishing features of superior performers (Spencer & Spencer, 1993)

Competency	Description	
Achievement and action		
Achievement orientation	Task accomplishment, seeks results, innovation, competitiveness, impact, standards, efficiency	Soft
Concern for order, quality and accuracy	Monitoring, concern for clarity, reduce uncertainty, keeping track	Soft
Initiative	Bias for action, decisiveness, strategic orientation, proactive, seizes opportunities, self motivation, persistence	Soft
Information seeking	Problem definition, diagnostic focus, looking deeper, contextual sensitivity	Soft
Interpersonal understanding	Empathy, listening, sensitivity to others, diagnostic understanding, awareness of others feelings	Soft
Customer service orientation	Helping and service orientation, focus on client needs, actively solves client problems	Soft
Impact and influence		
Impact and influence on others	Strategic influence, impression management, showmanship, persuasion, collaborative influence	Soft
Organisational awareness	Understands organisation, knows constraints, power and political astuteness, cultural knowledge	Soft
Relationship building	Networking, establish rapport, concern for stakeholders e.g. clients, use of resources, contacts use	Soft
Managerial		
Developing others	Training, developing others, coaching, mentoring, providing support, positive regard	Soft
Directiveness	Assertiveness, decisiveness, use of power, taking charge, firmness of standards, group control and discipline	Soft
Teamwork and co-operation	Fosters group facilitation and management, conflict resolution, motivating others, good climate	Soft
Team leadership	Being in charge, vision, concern for subordinates, build sense of group purpose, group motivation	Soft
Cognitive		
Analytical thinking	Thinking for yourself, reasoning, practical intelligence, planning skills, problem analysing, systematic	Hard
Conceptual thinking	Pattern recognition, insight, critical thinking, problem definition, can generate hypotheses, linking	Hard
Technical expertise	Job related technical knowledge and skills, depth and breadth, acquires expertise, donates expertise	Hard
Personal effectiveness		
Self control	Stamina, resistance to stress, staying calm, high EQ, resists temptation, not impulsive, can calm others	Soft
Self confidence	Strong self concept, internal locus of control, independence, ego strength, decisive, accepts responsibility	Soft
Flexibility	Adaptability, ability to change, perceptual objectivity, staying objective, resilience, behavior is contingent	Soft
Organizational commitment	Align self and others to organizational needs, business-mindedness, self sacrifice	Soft

Appendix B
The Survey Instrument Used in the Study

SECTION B
COMPETENCY DESCRIPTIONS

Please read the following descriptions of each competency before completing question B.1.

Teamwork & cooperation (fosters group facilitation and management, conflict resolution, motivation of others, creating a good workplace climate)
Flexibility (adaptability, perceptual objectivity, staying objective, resilience, behaviour is contingent on the situation)
Relationship building (networking, establish rapport, use of contacts, concern for stakeholders eg clients)
Computer literacy (able to operate a number of packages and has information management awareness)
Conceptual thinking (pattern recognition, insight, critical thinking, problem definition, can generate hypotheses, linking)
Technical expertise (job related technical knowledge and skills, depth and breadth, acquires expertise, donates expertise)
Organisational awareness (understands organisation, knows constraints, power and political astuteness, cultural knowledge)
Concern for order, quality & accuracy (monitoring, concern for clarity, reduces uncertainty, keeping track of events and issues)
Impact & influence on others (strategic influence, impression management, showmanship, persuasion, collaborative influence)
Initiative (bias for action, decisiveness, strategic orientation, proactive, seizes opportunities, self motivation, persistence)
Customer service orientation (helping and service orientation, focus on client needs, actively solves client problems)
Developing others (training, developing others, coaching, mentoring, providing support, positive regard)
Directiveness (assertiveness, decisiveness, use of power, taking charge, firmness of standards, group control and discipline)
Team leadership (being in charge, vision, concern for subordinates, builds a sense of group purpose)
Analytical thinking (thinking for self, reasoning, practical intelligence, planning skills, problem analysing, systematic)
Self control (stamina, resistance to stress, staying calm, high Emotional Quotient, resists temptation, not impulsive, can calm others)
Organisational commitment (align self and others to organisational needs, businessmindedness, self sacrifice)
Ability and willingness to learn (desire and aptitude for learning, learning as a basis for action)
Interpersonal understanding (empathy, listening, sensitivity to others, diagnostic understanding, awareness of others' feelings)
Self confidence (strong self concept, internal locus of control, independence, positive ego strength, decisive, accepts responsibility)
Personal planning and organisational skills
Written communication
Information seeking (problem definition, diagnostic focus, looking deeper, contextual sensitivity)
Achievement orientation (task accomplishment, seeks results, employs innovation, has competitiveness, seeks impact, aims for standards and efficiency)

Appendix B *Continued*

B.1 Please complete the table below, indicating from your perspective the *importance* for science and technology graduates entering the workforce, of each of the competencies listed. Please circle the number of your choice. (Refer attached description of each competency.)

COMPETENCY	**IMPORTANCE TODAY**							**IMPORTANCE IN 10 YEARS TIME**						
	Unimportant → Important							**Unimportant → Important**						
	1			→			**7**	**1**			→			**7**
Teamwork & cooperation	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Flexibility	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Relationship building	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Computer literacy	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Conceptual thinking	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Technical expertise	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Organisational awareness	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Concern for order, quality and accuracy	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Impact and influence on others	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Initiative	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Customer service orientation	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Developing others	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Directiveness	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Team leadership	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Analytical thinking	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Self control	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Organisational commitment	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Ability and willingness to learn	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Interpersonal understanding	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Self confidence	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Personal planning and organisational skills	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Written communication	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Information seeking	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Achievement orientation	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Please add others, if required:														
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	1	2	3	4	5	6	7	1	2	3	4	5	6	7