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Corrleating IS Curriculum with IS Career Development: A Culturally Based Study

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Abstract:

This paper reports on the findings of a longitudinal research study to evaluate the effectiveness of IS education program by relating this to the career development requirements of IS professionals who graduated from these programs. This report covers a period up to five years after graduation.

The study asks respondents to identify the most important IS skills required now and in five years time; the perceived emphasis of IS skills which were imparted through the IS curriculum and; the perceived relevance of these skills to the requirements of their jobs now and in the future.

The results suggest that while there is a close match between the needs of today and the training received there will be an ever widening gap with the needs of the future. Where serious discrepancies currently exist these relate to interpersonal and business skills. The methodology used allows curriculum designers to clearly identify directions for improvement and specific topics for introduction to revised courses. This has the advantage of being related specifically to the cultural environment in which the course operates and so the IS program can more closely meet the needs of the local IS community.

1 Introduction

Much has been written about the changing "IS paradigm" and the impact which this will have on the skills and knowledge requirements of IS professionals in the future (Green 1989; Cheney et al 1990; Trauth et al, 1993; Burn et al 1994). Little of this research, however, has been supported by input from the average IS professional. Educators, managers and IT experts have all been surveyed and this data has then been analyzed and correlated to produce a consensus view.

The paper reviews some previous research work which has given rise to the concept of a new IS paradigm and related research on IS skills requirements and IS curriculum development. This research study reports on the views of IS professionals in Hong Kong both with respect to their programs of academic studies in IS and the job requirements they perceive. These two views from the same group are then matched to identify the relevance of IS programs now and for the future. The implications for IS curriculum are discussed and related specifically to program changes which should be implemented to meet the current and future needs of the Hong Kong environment. Finally, the methodology and its application are reviewed and suggestions made for similar work of this nature to continue.

2 The Changing IS Paradigm

A number of recent studies have suggested that an IS paradigm shift has created different job descriptions for IS professionals which requires them to acquire new knowledge and skills. The ideal IS professional of the 21st century will be multifaceted individuals. They will possess a combination of interpersonal, technical and business skills that will allow them to analyze problems, integrate applications, and implement new business processes built around information technology (Farwell et al, 1992).

Acceptance of this concept has renewed interest in research in the area of IS skills requirements, IS staff motivation and IS staff management. It has also stimulated activity in IS curriculum development since many of the academic programs on offer still operate life-cycle related training which is more closely related to hierarchical career development within a centralized IT department. The findings of recent studies would suggest that rather than emphasizing technical skills IS programs should concentrate on the development of interpersonal and business skills (Leitheiser 1992, McLean et al 1991, 1994). These findings have also been supported by in-company research.

Aetna Life & Casualty, one of the largest insurance companies in the United States, undertook a major project to uncover the skills and knowledge which were likely to be needed in the 1990s (UCG 1988). Teams were established to study various business areas. One team focused on IS professionals. They found that the future IS professionals will need to know more about business issues and be able to apply information technology to those issues. They also

pointed out that IS professionals already had many of the needed technical skills, but not interpersonal skills, business knowledge, or project management skills.

A brief review of the most recent research work strongly supports this view. Green (1989) in his study attempted to find out the perceived importance of system analysts' job skills, roles, and non-salary incentives in the United States. The participants (systems analysts and users) were requested to indicate how strongly they believed the twenty-one skills, the twenty job roles and the ten non-salary incentives were for systems analysts in systems development. A total of 872 questionnaires was returned from the participating organizations. Results showed that systems analysts recognized the importance of behavioral skills for effective development, such as diplomacy, politics, and sales, while users expected systems analysts to exhibit technical skills, such as programming.

As a continuation of their 1980 research Cheney et al. (1990) conducted another study through structured interviews with senior IS managers responsible for planning, training, and hiring IS personnel in the United States. The IS managers were asked to rate the importance of twenty specific skill areas for each of the three major IS worker job categories. These are: project manager, systems analyst/designer, and programmer. In general, the study indicated that senior IS managers believed that human factors and managerial skills have and will continue to increase in importance for all IS workers, particularly for project managers.

Nelson (1991) in his study asked IS personnel and end-user personnel from eight US organizations to identify the perceived usefulness and perceived proficiency of thirty different IS skills grouped within six constructs. These are organizational knowledge, organizational skills, organizational unit, general IS knowledge, technical skills, and IS product. Results from 275 questionnaires showed that the perceived usefulness of organizational skills (organizational knowledge, organizational skills, and organizational unit) were rated higher than those of technical skills (general IS knowledge, technical skills, and IS product).

In a two-year research project by the Boston chapter of the Society for Information Management (Farwell et al. 1992), the key issues concerning the changing needs of IS professionals for the rest of the 1990s were examined. A group of ninety-eight IS practitioners, including IS managers, user manager, and IS consultants in the Northeastern United States, were asked to rate the importance of a list of IS activities and a list of IS technical skills. The study found that there was a shift in emphasis away from the traditional IS activities and skills. Future tasks and skills will be centered on reorientation of technology to solve business problems and the integration of business functions to provide competitive advantages. The ideal IS professionals of the 1990s should possess a combination of interpersonal, technical, and business skills.

Leitheiser (1992) undertook a study to identify the most important skills for systems developers from the IS managers' perceptions, both for the early 1990s and projected into the year 2000. The fifty-four IS skills were assigned to seven categories: analysis and design, programming, interpersonal, business, environment/platform, computer languages, and applications. A usable sample of 107 IS managers were produced. Results showed that interpersonal and business skills were ranked more important while knowledge of environment/platform and computer languages were considered relatively less important.

Most recently Trauth et al. (1993) used data from four groups - IS managers, end-user managers, IS consultants, and IS professors - to identify the key skills and knowledge that will be required of future professionals. The eighteen IS abilities were arranged into three categories: human, business, and technical. Results from 131 responses showed that the top six abilities fell under the human and business categories while only one technical skill was ranked in the top ten.

In Hong Kong, Chau and Tye (1993) conducted a study to find out the current and projected IS skills required of IS personnel as perceived by IS managers (based on Leitheiser's survey in 1990). 116 returns showed that interpersonal skill was the most important skill while environment/platform and computer languages skills were the least important both in 1993 and 1998.

In summary, these prior studies into IS skills have indicated that there has been a demonstrated shift in emphasis away from purely technical knowledge and skills towards strong interpersonal and business skills. All of these research studies support a strong shift in emphasis towards behavioral skills rather than those with a technical orientation but very few IS programs appear to emphasize this even where evolutionary change has been reported (Richards and Sandford 1992). This may actually reflect the reality of hiring policies where IT managers expectation of "techies" from IS programs leads them to recruit their staff from business programs and induct them through in-house training programs.

3 The Research Study

In Hong Kong there has always been a close association between industry and academia particularly with regards to program development. As a result a research project was initiated to study the skill requirements of IS professionals currently, and five years hence. This study was not, however, to rely solely on the views of management (who often declare noble aspirations but fail to live up to these in practice) or academics (who prefer to teach that which they know) but to reflect the harsh reality of the IS field workers. In order to do this, the IS graduate population

from the previous five years was used as the sample population.

The objectives of the study were to examine the current perception of IS skill importance; how that importance is expected to change over five years and; the emphasis of IS curricula on these skills. From this it would be possible to examine whether the academic training the IS professionals received could be useful to them at present and in their further career development. More importantly, from the study, information would be provided for educational institutions to adjust their program curricula and relate this specifically to the IS environment in Hong Kong.

3.1 The Methodology

A mail questionnaire approach was selected as the means to collect data for the study. The questionnaire included general questions on company and personal characteristics, the importance of different modules received for career development, the importance of different IS skills and their relevance in the IS program.

The questions which asked the perceived importance of different IS skills required, were adapted from Leitheiser's survey conducted in 1990. These skills items were created by reviewing the skill lists from the ACM Curriculum Committee, previous empirical studies, and a list of important technologies. All items on the questionnaire were ordered randomly and were weighted equally to arrive at a composite maturity score.

A total of fifty-four skills items was included in the questionnaire and were assigned to the following skill categories:

1. Applications Knowledge
2. Business Skill
3. Analysis & Design Skill
4. Environment/Platform Knowledge
5. Interpersonal Skill
6. Computer Languages Knowledge
7. Programming Skill

For each skill item the respondents were asked to rate the importance of the item twice, once for 1993 (present) and another one for 1998 (five years later), as well as the level of relevance of the IS curriculum received. In all cases, the respondents were asked to rate on a Likert scale 1 to 5, with 1 meaning "not important at all" and 5 meaning "extremely important" for importance of skill, and with 1 meaning "not relevant at all" and 5 meaning "extremely relevant" for relevance of curriculum.

3.2 The Participants

All computing graduates who graduated in 1988 to 1993 from Department of Computing, Hong Kong Polytechnic, were chosen in this study. A total of 395 graduates were included in the mailing list. The questionnaires were sent with covering letter explaining the study and self-addressed envelope. Questionnaires were completed and mailed/faxed directly to the researcher.

Of the 395 questionnaires mailed, a total of 100 questionnaires was returned from the past graduates as shown in Table 1, yielding a response rate of 25.3 percent. Another similar study (Chau and Tye 1993) also exhibited similar response rate of 26.5 percent. This rate is deemed acceptable and understandable given the length of the questionnaire, inaccuracies in the mailing list, and the high rate of immigration for IS professionals.

Graduation Year	No. of Student	No. of Response	Response Rate	Percentage of Respondent by Year
1988	32	5	15.6%	5.0%
1989	72	14	19.4%	14.0%
1990	76	20	26.3%	20.0%
1991	69	13	18.8%	13.0%
1992	76	25	32.9%	25.0%
1993	70	23	32.9%	23.0%
Total	**395**	**100**	**25.3%**	**100%**

Table 1: Respondents' Profile

4 The Results

4.1 Perceived Important IS Skills in Hong Kong

Figure 1 shows the mean importance ratings for the seven categories of IS skills required of IS professionals both in 1993 and 1998. The measure of relative importance was set at a 5-point Likert scale with 5 being "extremely important", 3 being "important", and 1 being "not important at all".

Two set of research hypotheses, for supporting further analysis, are put forward as follows:

Set 1:

H0: There is no statistically significant difference among the seven IS skills categories with respect to the perceived level of importance in 1993.

H1: There is a statistically significant difference among the seven IS skills categories with respect to the perceived level of importance in 1993.

Set 2:

H0: There is no statistically significant difference among the seven IS skills categories with respect to the perceived level of importance in 1998.

H1: There is a statistically significant difference among the seven IS skills categories with respect to the perceived level of importance in 1998.

A One-Way ANOVA analysis using F-test with a significance level of 0.05 was used to analyze the data as they pertain to the above research hypotheses. Results showed that the null hypotheses of both sets are rejected ($p < 0.001$). Therefore, there is a statistically significant difference among the seven IS skills categories with respect to the perceived level of importance both in 1993 and 1998.

4.2 Curriculum Emphasized IS Skills

The survey also asked respondents to rate the perceived relevance of the IS program studied to the IS skills they now identified as important to their jobs. Figure 2 shows the mean curriculum relevance ratings for the seven categories of IS skills in the IS Curriculum under study. Again, the measure of relative relevance is set at a 5-point Likert scale.

From Figure 2, we can observe that, from the viewpoint of graduates, the IS curriculum is not so relevant to the requirements of IS industry on the whole. None of the IS skill categories has a mean relevance rating greater than three. Again, for supporting further analysis, another set of research hypotheses are stated as follows:

Set 3:

H0: There is no statistically significant difference among the seven IS skills categories with respect to the level of relevance of the IS curriculum (overall) under study.

H1: There is a statistically significant difference among the seven IS skills categories with respect to the level of relevance of the IS curriculum (overall) under study.

Once more, One-Way ANOVA analysis using F-test with a significance level of 0.05 is used to analyze the data. Results showed that the null hypotheses is rejected ($p < 0.001$). Therefore, there is a statistically significant difference among the seven IS skills categories with respect to the level of relevance of the IS curriculum under study.

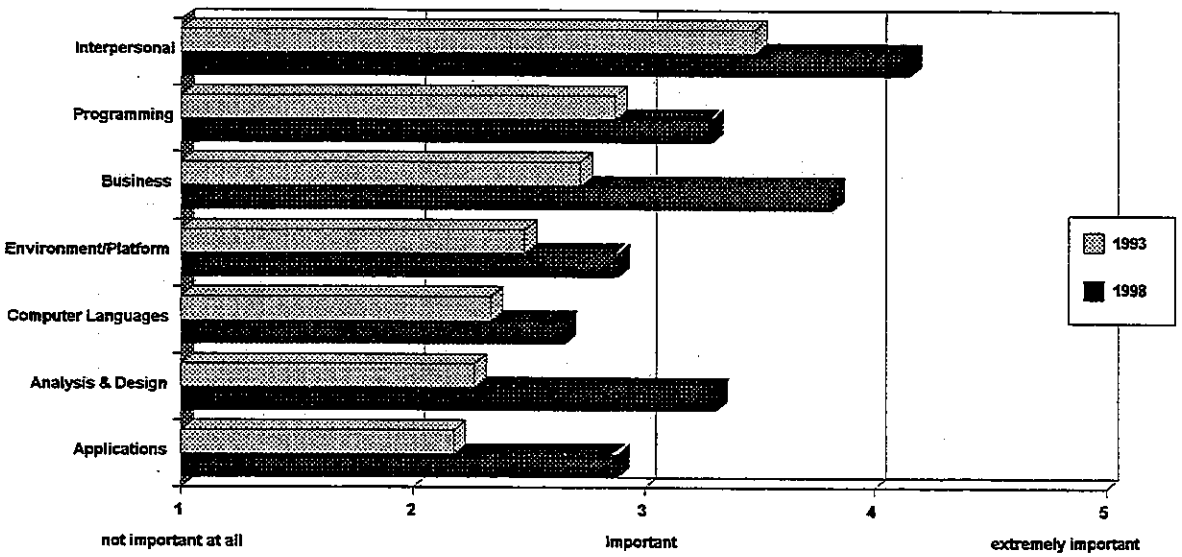

Figure 1 : Mean Importance Ratings for the Seven Categories of IS Skills

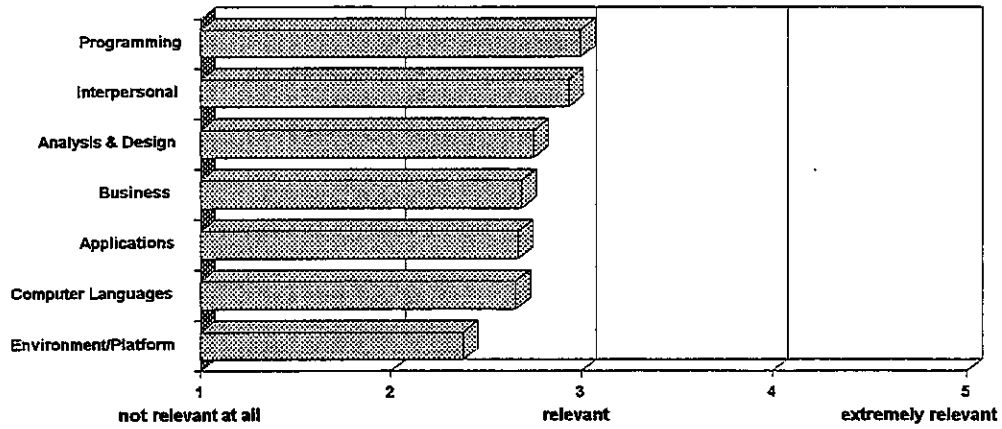

Figure 2 : Mean Curriculum Relevance Ratings for the Seven Categories of IS Skills in the IS Curriculum Under Study

4.3 Important IS Topics for Career Development

In the second part of the questionnaire, respondents are asked to rate a list of IS modules in terms of the relative importance for their career development. Again, the measure is set at a 5-point Likert scale with 5 being "extremely important", 3 being "important", and 1 being "not important at all".

Table 2 shows Data Base Management, Computer Programming Principles, Communication & Interpersonal Skills, and Information Systems Analysis & Design are the four most important IS topics for IS professionals in their career development.

Rank	IS Topics	Score*
1	Data Base Management	3.95
2	Computer Programming Principles	3.68
3	Communication & Interpersonal Skills	3.67
4	Information Systems Analysis & Design	3.64
5	Data Communication & Networking	3.53
6	Industrial Placement	3.43
7	Final Year Project	3.29
8	Software Engineering	3.23
9	Computer Operating System & Architecture	3.22
10	Project Planning & Control	3.11
11	Management / Business Studies	3.09
12	Business Systems Project / Case Study	3.01
13	Information Systems in Organization	2.99
14	Real Time Systems	2.90
15	Computer Simulation	2.69
16	Quantitative Techniques in Business Systems	2.56
17	Artificial Intelligence	2.40
18	Expert Systems	2.28
19	Computer Graphics	2.12
20	Social & Professional Issues	1.98

* Score is between 1 and 5, the higher the score, the more important the topic.

Table 2: Top Twenty IS Topics and Their Importance

5. Industrial Requirement Versus Academic Preparation

Having discussed the IS skills which are perceived as important for IS professionals and the curriculum emphasized IS skills in Hong Kong separately, we now move to our main research question: Is the academic training which IS professionals receive useful to them at present and in their further career development?

The previous hypotheses testing showed that there is a statistically significant difference among the seven IS skills categories with respect to the perceived level of importance both in 1993 (from Hypothesis Set 1) and 1998 (from Hypothesis Set 2), and to the perceived level of emphasis of the IS curriculum (from Hypothesis Set 3). Therefore, it is important for both industry and education to have a considerable shared vision on the ranking of the seven IS skills categories in terms of importance and emphasis. Once ranking is matched, education should also make sure the level of emphasis matches with the level of what industry requires.

5.1 Overall Picture

In terms of ranking, as shown in Table 3, there are good matches on Interpersonal Skill and Computer Languages Knowledge between the IS curriculum emphasis and industry requirements both in 1993 and in 1998. Emphasis on Programming Skill and Business Skill are matched with importance of 1993, but not with that of 1998. Emphasis on Analysis & Design Skill and Applications Knowledge are not matched with importance of 1993, but matches are found with that of 1998. Emphasis on Environment/Platform Knowledge is not matched with importance of both 1993 and 1998.

However, in terms of mean score, Figure 3 shows that the level of curriculum emphasis does not match with the industry requirements well.

IS Curriculum Emphasis	Importance in 1993	Importance in 1998
Programming (2.99)	Interpersonal (3.47)	Interpersonal (4.15)
Interpersonal (2.93)	Programming (2.88)	Business (3.82)
Analysis & Design (2.75)	Business (2.71)	Analysis & Design (3.31)
Business (2.69)	Environment/Platform (2.48)	Programming (3.29)
Applications (2.67)	Computer Languages (2.34)	Environment/Platform (2.88)
Computer Languages (2.66)	Analysis & Design (2.27)	Applications (2.88)
Environment/Platform (2.38)	Applications (2.18)	Computer Languages (2.66)

Table 3 : Ranking of Importance and Emphasis of Seven IS Skills Categories

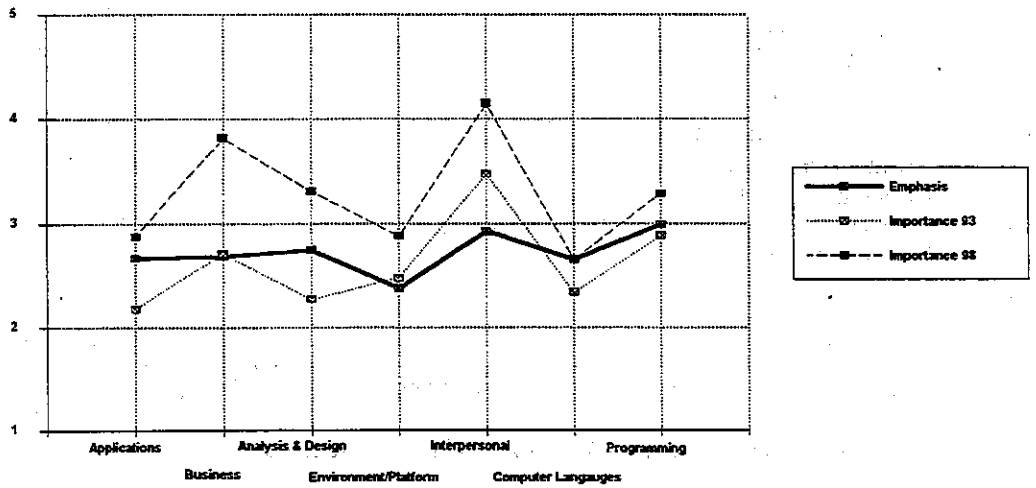

Figure 3 : Mean Score of Emphasis and Importance of the Seven IS Skills Categories

To show the match statistically, a paired-sample T-test with a significance level of 0.05 is conducted with the results shown in Table 4. Shared box indicates a pair of means that are different at the 0.05 level. A (=) sign indicates a balance between the level of emphasis and the level of importance. A (+) sign indicates the level of emphasis is greater than the level of importance while a (-) sign indicates the level of emphasis is less than the level of importance.

In addition, a Curriculum Correspondence Indicator (CCI) is calculated to show the extent to which IS programs provided by the tertiary institutions related to the skills required by the IS professionals for their career development. The measure of CCI is set at 1 to 100. The higher the CCI, the higher the correspondence. Whilst the CCI cannot give exact statistical comparisons since it relies on value judgments it does give an indication of considered value of the course components.

Unquestionably, a balance between curriculum emphasis and industry requirement is the optimum. If this is not the case, an over-emphasis is more desirable than a deficiency. From Table 4, we can observe that, apart from the deficiency of Interpersonal Skill, the IS graduates are well-trained for the current IS environment. However, as the increase in importance of all the seven IS skill categories in the future IS environment, the level of emphasis of all IS skill categories, with the exception of Computer Languages Knowledge, is found to be insufficient. A first conclusion is "the IS curriculum produces graduates for today, but not to meet the expectations of industry tomorrow".

5.2 IS Skills With Deficiency of Emphasis

After applying a paired-samples T-test on IS skill importance and its emphasis on IS curriculum, results showed that there are ten IS skills with deficiency of emphasis with respect to the level of importance of 1993 (Table 5). However, with respect to the increase in skill importance projected in 1998, another twenty-seven IS skills are found to be insufficient in emphasis, forming a total of thirty-seven IS skills deficient in emphasis.

	Emphasis-1993	Importance	Emphasis-1998	Importance
Applications	(=)	100	(-)	85.9
Business	(=)	91.7	(-)	60.4
Analysis & Design	(=)	100	(-)	76.8
Environment/Platform	(=)	91.4	(-)	73.7
Interpersonal	(-)	76.2	(-)	60.9
Computer Languages	(+)	94.7	(=)	88.2
Programming	(+)	98.8	(-)	86.4

Table 4 : Matching Between Curriculum Emphasis and Industry Requirements

Rank	Skill Type*	IS Skills	Deficiency #
1	I	Ability to respond appropriately to another's emotions	1.22
2	I	Ability to listen to others	1.16
3	I	Ability to persuade others	1.15
4	I	Ability to train others	1.09
5	B	Have an understanding of a specific business function	1.07
6	I	Ability to write clearly and effectively	0.79
7	I	Ability to work alone to accomplish some goals	0.73
8	I	Ability to work with others to accomplish some goals	0.72
9	L	Ability to use operating system Job Control Languages	0.64
10	E	Ability to build systems in a mainframe environment	0.62

* A : Applications B : Business D : Analysis & Design
E : Environment/Platform I : Interpersonal
L : Computer Languages P : Programming

Deficiency = [(Importance '93 - Emphasis) + (Importance '98 - Emphasis)] ÷ 2

Table 5 : IS Skills with Deficiency of Emphasis Both in 1993 and in 1998

Applications Knowledge	1993 Matching		1998 Matching	
Ability to design distributed applications	(+)	100	(-)	75.6
Ability to design collaborative work applications	(=)	100	(-)	71.2
Ability to design relational database	(+)	100	(=)	98.3
Ability to perform analysis and design for expert systems	(+)	100	(=)	100
Ability to create effective Executive Support Systems	(+)	100	(-)	73.9
Ability to create effective Decision Support Systems	(+)	100	(-)	82.3
Ability to design hierarchical or network databases	(+)	100	(+)	100

Shared box indicates a pair of means that are significantly different at the 0.05 level
(+) level of emphasis is significantly greater than level of importance
(-) level of emphasis is significantly less than level of importance
(=) balance between level of emphasis and level of importance

Table 6. Matching Between Emphasis and Importance on Applications Knowledge

Of the ten IS skills with deficiency of emphasis both in 1993 and 1998, seven are Interpersonal Skill, the other three are Business Skill, Environment/Platform Knowledge, and Computer Languages Knowledge, respectively.

A detailed analysis is completed on each of the seven skills areas and an example is shown in Table 6 as to how conclusions could be drawn with respect to the new input requirements for the IS curriculum.

From Table 6 we can observe that there is a good match between IS curriculum and the current IS environment. Apart from "Ability to design collaborative work applications", graduates seem to be over-trained on all other applications knowledge areas for the current IS culture in Hong Kong. However, this is not the case for the future where considerable changes are envisaged. These can be summarized as follows:

- The growing need for distributed processing and client-server models.
- Collaborative work tools will become more important.
- Growth in the use of Executive Support Systems and Decision Support Systems .

5.3 Key Issues for Preparing Future IS Professionals

We therefore return to our main question "Are IS programs providing the right type of education for future IS professionals?" To have a concise picture, Table 7 lists the top twenty IS skills with largest deficiency between future importance and emphasis regard as the key issues for preparing future IS professionals.

Obviously, Interpersonal Skill and Business Skill are the two main IS skill categories that require more attention by the IS curriculum. Of the twenty key issues, thirteen of them are either Interpersonal Skill or Business Skill. More importantly, the top twelve key issues fall into these two categories. For the other key issues, four are Analysis & Design Skill, two are Programming Skill, and one is Environment/Platform. Knowledge. Relatively speaking, the IS program outperforms on Applications Knowledge and Computer Languages Knowledge as no IS skills within these two categories are regarded as key issues.

Rank	+	IS Skills	Deficiency *
1	I	Ability to persuade others	1.632
#2	I	Ability to respond appropriately to another's emotions	1.585
#2	I	Ability to train others	1.585
4	B	Ability to foresee problems that would result from introduction of new technology	1.511
5	B	Have an understanding of a specific business function	1.462
6	B	Ability to assess the usefulness of new technologies	1.394
7	I	Ability to listen to others	1.389
8	B	Ability to do project planning and control	1.213
9	B	Ability to use techniques for identifying applications that will provide competitive advantages	1.075
10	I	Ability to write clearly and effectively	1.043
11	B	Have an understanding of industry structure and behavior	1.000
12	I	Ability to work with others to accomplish some goals	0.926
13	P	Knowledge of systems development quality assurance procedures	0.916
14	D	Ability to do an adequate feasibility study	0.913
15	I	Ability to work alone to accomplish some goals	0.894
#16	D	Ability to do a cost/benefit analysis of alternative system designs	0.892
#16	P	Ability to design security, privacy, and auditing controls for applications	0.892
18	E	Ability to build applications in a UNIX environment	0.883
19	D	Ability to do a cost/benefit analysis of alternative packages or tools	0.862
20	D	Ability to perform object-oriented analysis and design for applications	0.720

\+ A : Applications B : Business D : Analysis & Design
E : Environment/Platform I : Interpersonal L : Computer Languages
P : Programming

* Deficiency = Importance '98 - Emphasis # Same deficiency value

Table 7 : Key Issues for Preparing Future IS Professionals

6.0 Conclusion

As IS tasks and skills begin to center on reorientation of IS to solve business problems and the integration of business functions to provide competitive advantages, tertiary institutions, the main supplier of future IS man force, should provide training on a combination of interpersonal, technical, and business skills. However, most of the existing programs are either toward the technical end or toward the organizational end.

From this study, it is found that there is a statistically significant difference among the seven IS skills categories, namely Applications Knowledge, Business Skill, Analysis & Design Skill, Environment/Platform Knowledge, Interpersonal Skill, Computer Languages Knowledge, and Programming Skill, with respect to the perceived level of importance both in 1993 and 1998, and to the perceived level of emphasis of the IS curriculum. Programming Skill is the most emphasized IS skill category in the IS curriculum, followed by Interpersonal Skill, Analysis & Design Skill, Business Skill, Applications Knowledge, and Computer Languages Knowledge. Environment/Platform Knowledge is the least emphasized IS skill category. Thus, we can conclude that "the IS curriculum produces graduates for today, but not for the needs of tomorrow".

Failure to respond to market changes by the IS curriculum and lack of contact or understanding between educators and practitioners are the two main reasons for explaining the mismatch. Therefore, educators and practitioners must form a solid partnership to effectively meet the challenges of the paradigm shift facing the IS profession. Both parties must strengthen the channels of communication so that they can continually refine the skill requirements necessary for success in the future.

One way to meet this challenge is to review IS education programs by IS graduates in order to reflect not only the rapid changes in the IS world but also their relevant contributions. This research study has made the first step. Through the feedback of IS professionals, the study attempts to highlight the similarities and differences between curriculum emphasis and industry requirements of IS skills. From the findings, IS educators should be aware of the areas in which deficiencies exist and change the IS curriculum accordingly to prepare graduates for the future.

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