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Knowledge and skills of IS graduates : a Hong Kong perspective

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**KNOWLEDGE AND SKILLS
OF IS GRADUATES:
A HONG KONG PERSPECTIVE**

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KNOWLEDGE AND SKILLS OF IS GRADUATES: A HONG KONG PERSPECTIVE

ABSTRACT

The results of a survey of Hong Kong employers concerning the knowledge and skills of IS graduates are presented. In the survey, both the needed and actual levels of knowledge and skills together with their perceived importance are rated by IT managers and professionals in Hong Kong. Differences between needed and actual levels for important IT knowledge and skills are analyzed and serve as guidelines for improvement in IS education in Hong Kong. Results are also compared with similar surveys conducted on IS graduates in Taiwan and the U.S.

INTRODUCTION

Hong Kong, a small territory without natural resources except a deep-water harbor, has grown rapidly in economic terms; its GDP has grown at approximately seven per cent per year in real terms in the last two decades (5). In 1996, Hong Kong's per capita GDP was valued at US\$24,500, behind only Japan and Singapore in Asia, and higher than that of the United Kingdom, Canada and Australia. In addition, since the mid-1980s, Hong Kong's service sectors have undergone continuing expansion together with the relocation of manufacturing processes to neighboring areas in mainland China. As a result, its tertiary services grew from around 67 per cent of GDP in 1980 to 84 per cent of GDP in 1995. With the rapid growth of Hong Kong's GDP and the increasing use of information technology (IT) in service sectors, the number of IT workers has also seen drastic increases. For example, the number of IT employees increased 8.9 per cent from December 1993 to January 1996 based on surveys of organizations with IT installations and/or IT employees in Hong Kong conducted by the Vocational Training Council of Hong Kong (10). In fact, IT manpower growth is generally patterned after the growth of GDP, underscoring a close and important relationship between the two.

The Committee on Information Technology of the Vocational Training Council conducted a survey from December 1995 to January 1996 to assess the manpower and training needs in the IT sector so it could recommend measures to meet IT professionals' needs (10). The survey showed that

out of 38,069 IT employees, 8,029 (21.1%) were application programmers and 5,857 (15.4%) were in systems analysis area, the traditional positions targeted by information systems (IS) programs at tertiary institutions. Thus, the combined number of 13,886 (36.5%) represents the magnitude of the core job market for IS graduates in Hong Kong. In addition, 6,777 (17.8%) in IT management and many positions in support, education, and training are also target positions for IS graduates. Using these baseline numbers and forecasts for growth and turnovers, demand for both degree holders and other education qualifications were estimated by the Committee. It is estimated that the average supply of 1,570 local degree graduates from IS or computing disciplines forms the backbone of the IT labor force. However, potential employers are more interested in knowing that IS graduates from tertiary institutions possess the desired knowledge and skills rather than being informed that head counts are adequate.

The purpose of this paper is to identify those knowledge and skills deemed important by prospective employers of IS graduates from tertiary institutions in Hong Kong. In addition, it attempts to assess the expected and actual levels of expertise of those knowledge and skills. The magnitudes of the gaps between the two will provide valuable information for IS academics to improve and update IS curriculum at their institutions. After the Introductory section, relevant prior research in the area is reviewed in the Background and Literature Review section. Next, research methodology of the study is described. The fourth section contains findings and summary of the study. The conclusion and recommendations are in the fifth section. In the last section, a comparison of study results and those of similar studies conducted previously is made.

BACKGROUND AND LITERATURE REVIEW

Since IS is a relatively new discipline that it builds on the fast changing technologies, IS educational issues are important research subjects among academics. For curriculum development and update, surveys are often carried out to identify important IS subjects and to assess the IT knowledge and skills needed for IS graduates. Most of these surveys were conducted in the U.S. (2,1,6,7,8,11,12,14) due to the fact that IS programs have a longer history in the U.S. Results generally show that communication, interpersonal skills, and general IS knowledge are as important

or more important than technical knowledge. With the recognition of possible different requirements for IS graduates for employers for South East Asia employers, a limited number of studies have been conducted to identify the IT knowledge and skill requirements for IS graduates in those regions (3,13,15).

Chau and Ng Tye (1995) conducted a study in 1993 to find out the types of IT skills required of IT personnel in Hong Kong from IT management's perspective. They identified the order of importance of those skills at that time and five years hence and compared their results with a counterpart study in the U.S. In their study, fifty-four IT skills were grouped into seven categories: Skills in analysis and design, Programming, Interpersonal, Business, and Knowledge of environment/platform, Computer languages and Applications. In 1993, the highest rated categories of skills by Hong Kong IT managers were Interpersonal skills, followed by Business skills, Programming skills, Analysis and design skills, Application knowledge, Environment/platform knowledge and Computer languages knowledge. Those IT managers believed that in 1998 the most important skills would become Business skills and Analysis & design skills, followed by Interpersonal and Programming skills with the rest of the rankings unchanged. In the U.S. study, Interpersonal skills is consistently ranked at the top for 1990, 1995 and 2000. Generally speaking, U.S. managers rated Business skills next in line with Programming skills, Analysis & design followed by others with minor variations from Hong Kong rankings. In both studies, Interpersonal skills and Business skills were considered to be more important than technical skills.

Chau and Ng Tye's study was the first study to attempt to identify important knowledge and skills necessary for IT professionals in the Hong Kong environment. The knowledge and skill sets included, however, are IT specific except the category of Interpersonal skills. More generalized knowledge and skills were not included. In addition, English and Chinese communication skills which are critical in Hong Kong's environment are not specifically identified. Furthermore, no attempt was made to judge the degree of preparedness of IS graduates with respect to the knowledge and skills identified as important by IT professionals. Any knowledge of deficiencies in preparation

of IS graduates would certainly help tertiary institutions improving their IS programs to better meet the needs of the IT community.

In another Hong Kong study, Schmidt (1994) conducted interviews with IT managers in 18 large organizations in Hong Kong to identify the career path of IT personnel and the knowledge and skills required of them at different points in their career path. It was discovered that the IT career path generally begins with programming and that the important consideration for initial hiring decision was the applicants' ability to write code and their knowledge of the fundamentals of systems analysis and design. After the entry level programmer, most of the organizations would have programmer-analyst, systems analyst, project manager, and senior management positions in progression. Each tier would require a distinct set of knowledge and skills. Schmidt recommends that the target for IS graduates would be the skills of programmer with an introduction to the skills and knowledge of the systems analyst.

The IT managers in Schmidt's study were not asked to rate or rank a comprehensive set knowledge and skills. In addition, interviewed IT managers were from large commercial or governmental organizations in which IT jobs tend to be more compartmentalized and have a higher degree of division of labor. Again, the important issue of language skills in the environment of Hong Kong was not addressed.

In a survey conducted by Wang and Kahn (1994) to assess the knowledge and skills of IS graduates desired by companies in Taiwan, fifty-seven knowledge and skill subjects were grouped under categories of General knowledge and skills, Subject knowledge and skills, and Operation systems & programming languages and other specific skills. It was discovered that four general skills and five technical skills were perceived to require a high level of expertise. In terms of deficiencies or the differences between expected and actual expertise levels, the graduates were found to be lacking in all general knowledge and skill areas. They were also deficient in all technical skills except in Chinese/English word processing. In general, general knowledge and skills were perceived to require a higher level of expertise than more specific and technical skills and that graduates were perceived to be lacking more in general skills than in technical skills. A comparison

was also made between the results of the Taiwan survey and prior U.S. studies. It was found that skills derived from the newer information technologies were ranked higher in the U.S. studies than in Taiwanese study implying a time lag in the integration of newer technologies in Taiwan.

The questionnaire used in Wang and Khan's study was developed from multiple sources (12,9,6) covering not only IS specific knowledge and skills but also a more generalized knowledge base. This knowledge base is specific enough so that particular skills can be assessed, such as oral and written Chinese and English communication skills. The fact that needed expertise and actual expertise levels of IS graduates' knowledge and skills are rated enables deficient areas to be identified. Knowledge of these deficiencies provides helpful guidance for IS curriculum changes resulting in better prepared graduates. With these advantages in mind, Wang and Khan's questionnaire was modified and updated for use in this study. The specific knowledge and skills deemed relevant in the Hong Kong environment have also been added. The use of the questionnaire would also facilitate a comparison between the current findings with theirs.

THE METHODOLOGY

The research was carried out in two stages: A pilot study and the main survey. The structured questionnaire used in the survey was developed to gather data from IT managers in Hong Kong. Knowledge and skills subjects included in the questionnaire are shown in Table 1.

A pilot test was conducted on a small group of IS academics and IT managers. They were invited to critique the draft questionnaire including the wordings and items to be dropped or added. The feedback gained from the pilot study provided valuable input considered in the final construction of the questionnaire used in the main survey.

A reasonable claim of content validity for the questionnaire is supported by the following: (1) all items in the questionnaire were either adapted from questionnaires with high content validity used in prior studies or identified during the pilot study; (2) IS academics and IT professionals had the opportunity during the pilot study to evaluate the questionnaire's contents and readability; (3) the questionnaire was tested during the pilot study to ensure that it was complete and representative of the attributes being measured.

Table 1. Knowledge and Skills for IS Graduates

General Knowledge and Skills	Operation Systems & Programming Languages and other specific skills
1 Hardware knowledge 2 Information systems management 3 End-user issues 4 Management issues of IS department 5 Oral Chinese communication skills 6 Written Chinese communication skills 7 Oral English communication skills 8 Written English communication skills 9 Presentation skills 10 Project management skills 11 Management principles 12 Functional knowledge (eg Accounting, Marketing)	28 MS-DOS 29 OS/2 30 UNIX 31 Windows 3.1 32 Windows 95 33 Windows NT 34 Assembly languages 35 BASIC 36 COBOL 37 C 38 C++ 39 Visual Basic
Subject Knowledge and Skills	
13 Systems analysis & design 14 Operating systems 15 Database management systems 16 Electronic spreadsheet 17 Telecommunications/networks 18 Electronic commerce 19 IS strategic planning 20 Chinese/English word processing 21 Decision support systems 22 Artificial intelligence/Expert systems 23 CASE tools 24 Computer graphics 25 Computer programming 26 Software engineering 27 Internet technologies	40 ADA 41 PASCAL 42 Clipper 43 Informix 44 FOCUS 45 Oracle 46 Sybase 47 Powerbuilder 48 Prolog 49 LISP 50 DBASE 51 Foxpro 52 Access 53 EXCEL 54 LOTUS 55 RPG 56 HTML 57 Java

The survey targeted IT managers from different industries in Hong Kong. Four-hundred and fifty companies were randomly selected from the Hong Kong Computer Directory (1995). In the main survey, the questionnaires were mailed in April 1997 to IT managers of the targeted organizations. Respondents were asked to rate each item (except demographic items) on a 7-point Likert scale (1 = extremely low, 7 = extremely high). Extra space was provided so that respondents could have added more items. Fifty-seven usable responses were returned (13% response rate). Respondents were allowed to remain anonymous. Approximately 40 per cent of the respondents requested a copy of the findings when completed.

FINDINGS AND DISCUSSION

Most of the questionnaires were filled out by middle-level managers (33 or 57.9%) with the rest distributed fairly evenly among directors (4 or 7.0%), systems analysts (5 or 8.8%) and programmers (5 or 8.8%). In 10 cases the respondent's position was not identified. Finance sector has the highest respondents at 15 (26.3%) with Manufacturing ranked next at 13 (22.8%). Transportation and Government each has 7 (12.3%) respondents with the rest from other sectors. With respect to annual sales volume/budgets, 16 (28.1%) are above HK\$1,000 million with remaining firms fairly evenly distributed below this threshold. Almost one-third of the respondents (18 or 31.6%) did not provide sales volume/budget figures.

Findings of the survey are presented in order of General knowledge and skills, Subject knowledge and skills, and Operating systems & programming languages and other specific skills in Table 2. Among the General knowledge and skills entries, those with an average ratings of five or above in importance (in descending order) are: End-user issues, Written English communication skills, Oral Chinese communication skills, Information systems management, Project management skills, Oral English communication skills, and Presentation skills. Other entries such as Functional knowledge (e.g., Accounting, Marketing), Management issues of IS department, and Hardware knowledge were ranked between average (4) and slightly high (5) in importance. Among the top-ranked seven items, three are language skills and others such as End-user issues, Project management skills, and Presentation skills are related to communication and interpersonal skills.

In terms of needed expertise level, the top five items in the General knowledge and skills are: Written English communication skills (4.95), Oral Chinese communication skills (4.79), End-user issues (4.73), Oral English communication skills (4.71), and Information systems management (4.61). All five were ranked among the top six items of importance. It shows that employers not only regard both English and Chinese language skills important but also desire to see graduates have a high level of expertise in them. For the Actual expertise level possessed by graduates, only one item, Oral Chinese communication skills, was ranked above average (4.54). The lowest ones are

Hardware knowledge (2.80) and Management issues of IS department (2.98). This indicates that respondents regard graduates' General knowledge and skills in general quite low.

Table 2. Important Knowledge and Skills and Their Deficiencies

Knowledge/Skills	Level of Importance	Deficiency
General Knowledge and Skills		
1 Hardware knowledge	4.51	1.11*
2 Information systems management	5.57	1.20*
3 End-user issues	5.68	1.73*
4 Management issues of IS department	4.83	1.04*
5 Oral Chinese communication skills	5.63	0.25
6 Oral English communication skills	5.32	1.21*
7 Written English communication skills	5.64	1.46*
8 Presentation skills	5.18	1.05*
9 Project management skills	5.39	1.11*
10 Management principles	4.76	0.98*
11 Functional knowledge (eg Accounting, Marketing)	4.77	1.14*
Subject Knowledge and Skills		
12 Systems analysis & design	5.61	1.11*
13 Operating systems	4.95	0.76*
14 Database management systems	5.48	0.95*
15 Electronic spreadsheet	4.61	0.18
16 Telecommunications/networks	5.14	1.28*
17 IS strategic planning	4.50	1.11*
18 Chinese/English word processing	4.73	0.14
19 Decision support systems	4.09	0.75*
20 Computer programming	5.86	1.09*
21 Software engineering	5.04	0.82*
22 Internet technologies	4.84	0.40
Operation Systems & Programming Languages and other specific skills		
23 MS-DOS	5.09	0.17
24 UNIX	4.36	0.71*
25 Windows 3.1	5.48	0.37*
26 Windows 95	5.24	0.52*
27 Windows NT	4.89	0.86*
28 Foxpro	4.08	0.13
29 EXCEL	4.69	0.35

* Significant at 1% level

Differences between the Needed expertise level and the Actual expertise level possessed by graduates for important items in this category are listed under Deficiencies column in Table 2. The table shows that all important items in the category have mean deficiencies of greater than 1 and are significant at 1% level except Oral Chinese communication skills. This means that respondents regard graduates lacking preparation in important areas in General knowledge and skills necessary to perform their jobs with one exception: their ability to communicate using the native spoken language is acceptable.

With respect to Subject knowledge and skills, those ranked above five (slightly high) in importance (in descending order) are: Computer programming, Systems analysis & design, Database management systems, Telecommunication/ networks, and Software engineering. Those ranked between average (4) and slightly high (5) include: Operating systems, Internet technologies, Chinese/English word processing, Electronic spreadsheet, IS strategic planning, Decision support systems.

For Needed Expertise level, those ranked higher than average (4) (in descending order) are: Computer programming (5.41), Systems analysis & design (4.84), Database management systems (4.68), Telecommunications/networks (4.66), Software engineering (4.54), Operating systems (4.30), and Internet technologies (4.29). The top five entries for Needed Expertise level are identical to the top five entries for Level of Importance in Job. This signifies the higher requirement for those important knowledge and skills in the job. For the Actual expertise level possessed by IS graduates for the Subject knowledge and skills, all were rated below average (4) with only Computer programming rated above average (4.32). This shows that respondents regard graduates as generally less-prepared in IS subject knowledge and skills than they should be.

The items with mean deficiencies of greater than one in the Specific knowledge and skills are Telecommunications/networks, Systems analysis & design, and Computer programming. It shows that even though graduates possess above average computer programming knowledge and skills, in respondents' eyes, the level of expertise possessed is still insufficient.

As to Operating systems & programming languages and other specific skills, those ranked above average (4) in importance are: Windows 3.1, Windows 95, MS-DOS, and Windows NT. EXCEL, Foxpro. All others are rated below average. This shows that IT professionals regard knowledge of PC environment the most important among computer skills and that spreadsheet and database application skills are more important than traditional computer programming languages.

For Needed expertise level, those ranked higher than average (4) (in descending order) are: Windows 3.1 (5.20), Windows 95 (4.85), MS-DOS (4.65), Windows NT (4.56), EXCEL (4.35), and Unix (4.11). The rankings for Needed expertise level for all these items are similar to their rankings for Level of importance on the job. However, the ratings for the Needed expertise level are all lower than the ratings for Level of importance on the job. This means that even though those items are important, the Needed expertise level does not have to be very high. For the Actual expertise level possessed by graduates for Operating systems & programming languages and other specific skills, only four items were rated above average (4): Windows 3.1 (4.83), MS-DOS (4.48), Windows 95 (4.33), and EXCEL (4.00). All other items were rated below average. In other words, respondents regard graduates as generally less-prepared in Operating systems & programming languages and other specific skills.

Differences between the Needed expertise level and the Actual expertise level possessed by graduates with respect to Operating systems & programming languages and other specific skills are mixed. For the seven items rated as Importance in job, significant differences (at 1%) exist for Windows 3.1, Windows 95, Windows NT and UNIX. For other items, such as MS-DOS, Foxpro, and EXCEL, differences are not as great. It is interesting to note that for COBOL, C, and PASCAL, graduates were rated to have a higher level of actual expertise than needed.

CONCLUSION & RECOMMENDATIONS

Based on the above findings, some conclusions and recommendations may be drawn with respect to the status of preparedness of IS graduates in Hong Kong. For General knowledge and skills, prospective employers place language and communication skills as important as IS management knowledge and they also demand a much higher level of expertise than what the current

IS graduates possess for all items (except oral Chinese communication skills). Those items perceived as having greatest deficiencies are End user issues, Oral English communication skills, Written English communication skills and Information systems management. It shows that organizations in Hong Kong deem current IS graduates lacking preparation not only in IS discipline-based knowledge but also oral and written communication skills. It also means that tertiary institutions in Hong Kong should do a better job on imparting IS knowledge to students and should place a greater emphasis on their IS students' oral English skills and written English and Chinese skills.

Among Subject knowledge and skills, it is not surprising that the traditional subjects in IS such as Computer programming, Systems analysis and design, Database, Telecommunications/networks, and Software engineering were identified as important for IT jobs. Significant deficiencies in IT knowledge and skills possessed by graduates exists in practically all areas. Subjects with the greatest deficiencies are Telecommunications/ networks, Systems analysis & design, and Computer programming. This implies that current IS graduates still lack sufficient level of knowledge in IS core subject areas in prospective employers' eyes. The fact that ratings for Actual expertise level possessed by graduates are all less than average (4) for all IS subject matters except Word processing and Computer programming underscores this message.

For items in Operating systems & programming languages and other specific skills category, IS professionals place their emphasis on knowledge and skills in the PC environment and not the traditional programming languages. The fact that increasing deficiencies exist for MS-DOS, Windows 3.1, Windows 95, and Windows NT, in this order, may indicate a time lag between the commercial availability of these technologies and the integration of them in the IS programs. It is also the first time that the Actual expertise level possessed by graduates exceed the Needed expertise level for some items (such as BASIC, C, PASCAL). It may reflect the fact that many IS programs are still devoting much effort teaching the traditional programming languages which are not deemed as important any more by IT managers in Hong Kong.

In view of the above findings and conclusion, the following recommendations are made with the aim of improving IS curriculum at tertiary institutions in Hong Kong:

- a. Pattern the IS curriculum after a comprehensive curriculum model such as IS'95 Curriculum Model (4). This is by far the most well-balanced and up-to-date curriculum model. The breadth and depth of each subject is well articulated. The abilities and knowledge for IS graduates include not only IS knowledge and skills but also communication, interpersonal relationships, general management, business functional areas, problem solving and professionalism. An IS curriculum based on a curriculum model ensures that important subjects in an IS program are covered. The special characteristics of Hong Kong business and IT environments should then be incorporated into such a framework to meet the needs of the local employers of IS graduates.
- b. Place a greater emphasis on communication skills, especially oral and written English skills and written Chinese skills. This can be helped by incorporating or strengthening the business communication requirement (both in English and Chinese) in the program, requiring assignments such as project reports, case reports, term papers in most courses in the program. Project and case presentation in class would also improve students' oral and presentation skills. In addition, exit examinations for Chinese and English for all graduates from tertiary institutions may be warranted in view of the importance of the two languages in the Hong Kong environment to ensure that all graduates attain a minimum level of proficiency in both languages. (Lingnan College has decided to implement proficiency examinations in both Chinese and English beginning in the 1997-98 academic year).
- c. Improve the academic standards in the IS core courses by increasing the breadth and depth of coverage and by keeping up with the advances of technology in those areas. It is quite apparent that IT managers in Hong Kong are not satisfied with the level of knowledge and skills possessed by current IS graduates in most of the subject areas--not only in general knowledge and skills but also specific IS knowledge and skills. Since IS programs at different tertiary institutions may have different emphases, it is advisable for an IS program to establish a tracking system to identify the areas of deficiency of its own graduates in order to strengthen the coverage of those areas in the program.

- d. Emphasize PC operating systems/environments and PC skills, and de-emphasize the instruction of the traditional computer programming languages. This is due to the Hong Kong environment in which PCs and PC networks are the prevailing systems being used. However, a proper balanced should be achieved so that students are well-versed in PC technology yet at the same time have a basic understanding and knowledge of the traditional computer programming languages.

COMPARISON WITH OTHER STUDIES

In Wang and Khan's study (1994) a comparison was made between their Taiwan results and the results of several U.S. studies (11,12), and some broad generalizations were made. For example, U.S. studies found communication skills to be the most desirable skills of IS graduates. In the Taiwanese study, they were ranked below IS subjects. Also, the Taiwanese study ranked third generation programming skills in the top ten and the U.S. studies ranked these skills lower. Wang and Khan felt that the differences may be due to the time lag in the integration of newer technologies in Taiwan.

The results of this study are added to the Table of Comparison of Skill Deficiencies in Wang and Khan (Table 3) so that areas of desired and actual levels of expertise and deficiencies in the U.S., Taiwan, and Hong Kong may be compared. Nelson's (1991) results are eliminated because a high number of subjects were not investigated in his study. Since various studies used different scales, ranking of the items have been added for Expertise Desired, Expertise Possessed and Deficiency (Expertise Desired - Expertise Possessed) in Table 3. Also, the item Third generation languages was changed to Programming languages to include newer programming languages and some PC skills. The ratings for Communication abilities for the Hong Kong study are the averages of those of Oral English and Written Chinese and English skills. Oral Chinese skills are excluded for the term refers to Hong Kong's native language, the Cantonese.

The comparison results show that Communication abilities and Programming are the areas with the highest level of expertise desired in the U.S. study, followed by Systems analysis & design and Data base management systems. Communication abilities has also been identified as the most

Table 3. Comparison of knowledge and skills requirements among U.S. , Taiwan and Hong Kong

Skills	U.S.			Taiwan ***			HK***		
	Ravichandran/Gupta*								
	Exp. Des.	Exp. Poss.	Def.	Exp. Des.	Exp. Poss.	Def.	Exp. Des.	Exp. Poss.	Def.
Communication Abilities	8.0(1)	5.0(2)	3.0(1)	5.13(4)	3.19(5)	1.94(4)	4.81(3)↑	3.84(2)	0.97(5)
Systems Analysis & Design	6.5(2)	5.0(2)	1.5(4)	5.60(1)	3.36(4)	2.24(1)	4.84(2)	3.73(3)	1.11(3)
Data Base Management Systems	6.5(2)	4.0(3)	2.5(2)	5.40(2)	3.56(2)	1.84(6)	4.68(4)	3.73(3)	0.95(5)
IS Strategic Planning	3.0(5)	2.0(6)	1.0(5)	5.26(3)	3.06(7)	2.20(2)	4.05(7)	2.94(9)	1.11(3)
Telecommunications & Network	5.0(3)	3.0(5)	2.0(3)	4.85(7)	2.97(8)	1.88(5)	4.66(5)	3.38(6)	1.28(1)
IS Management	3.0(5)	2.0(6)	1.0(5)	5.09(5)	3.08(6)	2.01(3)	4.61(6)	3.41(5)	1.21(2)
Third Generation Languages***	8.0(1)	6.0(1)	2.0(3)	5.06(6)	4.88(1)	0.88(9)	5.41(1)	4.32(1)	1.09(4)
Decision Support Systems	3.5(4)	3.5(4)	0.0(7)	4.30(9)	2.46(9)	1.84(6)	3.71(8)	2.96(8)	0.75(6)
Object-Oriented Programming	3.5(4)	3.0(5)	0.5(6)	3.85(10)	2.39(10)	1.46(7)	3.26(9)	3.17(7)	0.09(7)
Operating Systems	2.0(6)	2.0(6)	0.0(7)	4.69(8)	3.45(3)	1.24(8)	4.30(7)	3.55(4)	0.75(6)
NI	Not Investigated								
*	On a scale of 1 through 9								
**	On a scale of 1 through 5								
***	On a scale of 1 through 7								
****	In the U.S. study, this skill was listed as Programming.								
↑	Average of Oral English and Written Chinese and English skills								
()	Ranking order of respective item								

efficient area before Data base management systems, Telecommunications & network and Programming languages. In the Taiwan study, Systems analysis & design, Data base management systems, IS strategic planning and Communication abilities are the areas with the highest level of expertise desired. The top deficient areas are IS strategic planning, Data base management systems and Telecommunications & network and Communication abilities. In comparison, the Hong Kong study indicates that Programming languages, Systems analysis & Design, Communication abilities and Data base management systems are the top four areas for expertise desired. Most deficient areas are Telecommunications & network, Systems analysis & design, IS strategic planning and Programming languages. The subjects ranked in the top four highest expertise desired in all three studies are: Communication abilities, Systems analysis & design, and Data base management systems. This ranking underscores their importance as the core knowledge and skills for IS graduates. The fact that Programming languages was ranked first in expertise desired in two studies indicates that it is the essential skill for the most likely first job for IS graduates, the entry-level programmer.

As far as deficient areas, Systems analysis & design and Communication abilities were singled out as major deficient areas in all three studies. IS strategic planning, Telecommunications & network and Programming languages were the major deficient areas in two studies. Common deficient areas in three studies point out the common problems exist in IS programs, regardless of location.

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