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Information systems education in the USA

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Fast changing information technology (IT) has posed tremendous challenges to information systems (IS) educational programmes. One question frequently asked by IS educators has been: 'Are we doing the right thing?' This article presents information about the current state of IS educational programmes in the USA based on a survey of 193 higher education institutions conducted at the end of 1996. The results indicate that IS educational programmes are prevalent in the higher educational institutions. These programmes have a highly qualified faculty: 92% or more holding terminal degrees, more than two-thirds having tenure, with evidence of an increasing amount of time being devoted to research activities. It is also found that the most popular programming languages taught in both graduate and undergraduate programmes are C/C++, SQL and COBOL, and dominant operating systems are Windows/OS2 and UNIX. The most profound change over the last five years in the content of IS programmes has been the transition from text-based and centralized mainframe environment to the graphical and decentralized network based client–server architecture. This survey provides a snapshot of IS programmes, serving both to improve our understanding of current programmes and to provide a frame of reference for future studies.

KEYWORDS: Higher education, curriculum development, information technology

INTRODUCTION

Driven by the dramatic development of information technologies (IT) and the explosive expansion in use of IT by organizations, information systems (IS) education has been under continued pressure to adapt itself to the changing environment. Studies of the required skills for IS professionals (e.g. Athey and Plotnicki, 1991; Mackowiak, 1991; Leitheiser, 1992; Trauth *et al.*, 1993; Lee *et al.*, 1995; Zhao, 1997) have strongly suggested that the dynamic nature of information technologies necessitates continuous reassessment of IS education curricula. Failure to update the curriculum to incorporate new technologies and new approaches to IS management can lead to programmes that, at best, teach material that is obsolete and, at worst, may instruct students in paradigms that are actually counterproductive in a world of distributed information and processing. Recent studies of IS education have expressed concerns that IS curricula may be failing to keep up with the realities of corporate information systems (e.g., Trauth *et al.*, 1993; Leidner and Jarvenpaa, 1995; Lee *et al.*, 1995).

Our ability to judge the validity of these concerns is hampered by the absence of current research about the nature of existing IS programmes. Certainly, descriptions of individual programmes abound, as do a number of noteworthy efforts to measure the needs of the employers of IS graduates (e.g., Stolen, 1992; Lee *et al.*, 1995). Absent from the literature, however, is an up-to-date description of what IS programmes are teaching and how they are organized. The most recent effort in this direction appears to be a 1989 study of the USA and Canadian undergraduate IS programmes by Longenecker and Feinstein (1991), and a small scale 1995 survey by Shah and Martin (1997). Given the changes of information technologies since that time, there is an urgent need for a comprehensive and up-to-date description of IS programmes.

The current paper presents the results of a survey of IS faculty in the USA. It is intended to serve as a useful frame of reference for IS academics who are considering redesign of their own programmes, and for IS practitioners who are involved in the curriculum design process at their local academic institution, or who are grappling with the question of whether or not to hire graduates of IS programmes.

METHOD

The survey

The survey, a complete copy of which is available upon request from the authors, was conducted as a joint project of the authors and a sponsoring company that specializes in undergraduate education products, with the immediate objectives of advancing the state of knowledge of IS education in the USA. It was also intended to provide information about existing IS programmes for a biannual reassessment of the undergraduate computer information systems major being conducted at the authors' university. The questions in the survey were designed to help address a number of questions, including:

(1) How is the IS discipline incorporated into the organization of institutions having one or more IS faculty members?
(2) What are the characteristics of faculty who teach IS programmes?
(3) What types of IS programmes are being offered at the undergraduate and

graduate levels and (4) how has the content of these programmes evolved in response to the fast changing IT over the last five years?

The survey instrument was mailed to IS faculty listed in the Management Information Systems Research Center (MISRC) directory in the USA in late October 1996, and responses were accepted through 15 January 1997. Before the survey was mailed out, it was pre-tested using IS faculty at the authors' institution. The pretest yielded a unanimous conclusion that the instrument was too long. As a result, approximately 25% of the questions in the original survey were eliminated. Because the authors felt that additional elimination would have required removing questions that appeared to be of considerable interest, the decision was made to accept the reduced response rate to be expected with such a complex instrument in order to acquire a richer picture from those who did respond. At the end, the instrument consists of eight sections each focusing on different aspects of IS education, with a total of 90 questions.

The respondents

The survey instruments were mailed out to over 2000 faculty members in 442 different educational institutions. Some 240 usable responses were received by the cut off date, a 12% individual response rate. Viewed in terms of institutions, the rate was much higher: surveys were returned from faculty at 193 different institutions, a 44% response rate. Responses were received from several different types of academic institutions, as shown in Table 1. Most of the respondents were affiliated with colleges and universities offering traditional four-year advanced degree programmes: about 84% of the responding institutions offered graduate level programmes, with 46% of them offering doctoral level degrees, and 38% offering Master's level degrees. Nearly all the institutions had a business school that functioned either as an autonomous (82%) or semi-autonomous (12%) unit. A number of different institutional affiliations were also present in the survey population, with public institutions (72%) and private institutions (25%) predominating.

More than 85% of the responding faculty members (Table 2) were affiliated with four-year graduate degree granting institutions. Among them, over 90% were professors, associate professors, and assistant professors, meaning the results represent

Table 1. Characteristics of the responding institutions

Institution type[a]	Number of institutions	Percentage (%)	Number of respondents	Percentage (%)
4YwD	89	46.11	117	48.75
4YwM	74	38.34	90	37.50
4YwU	22	11.40	25	10.42
Other	8	4.15	8	3.33
All	193	100	240	100

[a] 4YwD, 4YwM and 4YwU represent four-year colleges/universities with the highest degree offered being doctoral, Master's, and Bachelor's, respectively.

Table 2. Characteristic of responding faculty[a]

	Academic rank									
	Professor		Associate Professor		Assistant Professor		Instructor		Adjunct	
Institution[b]	No.	%	No.	%	No.	%	No.	%	No.	%
4YwD	34	29.06	46	39.32	26	22.22	6	5.13	0	0.00
4YwM	43	47.78	25	27.78	17	18.89	1	1.11	3	3.33
4YwU	7	28.00	7	28.00	9	36.00	1	4.00	1	4.00
Other	6	75.00	0	0.00	1	12.50	0	0.00	1	12.50
Overall	90	37.50	78	32.50	53	22.08	8	3.33	5	2.08

[a]Percentages are computed within institution types, except for the category 'Overall'.
[b]4YwD, 4YwM and 4YwU represent four-year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.

the views of educators, not administrators. The fact that there are more professors (37%) than assistant professors (22%) also suggests that the IS discipline has become quite mature from an academic perspective.

CURRENT STATE OF THE ART

Since the early days of IS education in the late 1960s, IS programmes have evolved in parallel with dramatic changes in information technologies that have been transforming every aspect of society, including IS education itself. In the following sections, we consider IS education programmes in the USA from three perspectives: the nature of IS educational programmes being offered, the characteristics of the IS faculty in various institutions, and the content of these IS programmes. This snapshot not only provides an understanding of the current state of IS education in the USA, but also serves as a reference frame for future studies of the evolution of this dynamic discipline.

Programmes offered

The increasingly important role of information technologies in modern society and the global economy has placed IS education in the centre stage of higher education in the USA. As an independent academic discipline, IS programmes are more popular than ever. It is only natural that a variety of IS programmes are being offered at various institutions, as shown in Table 3. Of the institutions surveyed, each of which had at least one IS faculty member, over 78% offered IS undergraduate major degrees, and over 34% also offered IS graduate degrees. While about the same percentage of four-year institutions in the three categories listed in Table 1 offered an IS undergraduate major, most of the graduate level IS programmes, which include IS Master's (46%), MBA with IS track (61%), and an executive IS programme (24%), were concentrated in the doctoral degree granting institutions.

Table 3. IS programmes offered by the responding institutions[a]

	Institution types[b]									
	4YwD		4YwM		4YwU		Other		Overall	
Programmes[c]	No.	%	No.	%	No.	%	No.	%	No.	%
IS major (U)	73	82.02	59	79.73	17	77.27	2	25.00	151	78.24
IS minor (U)	46	51.69	44	59.46	14	63.64	1	12.50	105	54.40
IS survey (U)	63	70.79	47	63.51	12	54.55	4	50.00	126	65.28
IS master (G)	41	46.07	21	28.38	4	18.18	1	12.50	67	34.72
MBA IS track	54	60.67	26	35.14	3	13.64	4	50.00	87	45.08
IS survey (G)	54	60.67	37	50.00	7	31.82	5	62.50	103	53.37
IS doctoral	36	40.45	1	1.35	2	9.09	3	37.50	42	21.76
Executive IS	21	23.60	4	5.41	2	9.09	2	25.00	29	15.03

[a]Limited to one response per institution. Percentages are computed with each institution type, except the overall category.
[b]4YwD, 4YwM and 4YwU represent four-year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.
[c]U, undergraduate programmes; G, graduate programmes.

Despite the popularity of IS programmes, the number of graduates from these programmes seems to be relatively small, as illustrated in Fig. 1. While most of the institutions graduate anywhere from 500 to 5000 undergraduates each year, less than 100 of them are IS graduates in most (78%) of the institutions. Given the severe shortage of labour with IT skills in the industry (King, 1997), and the explosive growth of IT related jobs, a rapid growth of IS programmes in the near future seems inevitable.

Figure 2 presents a quite interesting comparison between the credits required for an IS undergraduate degree and for an MBA with IS track. In order to get an IS

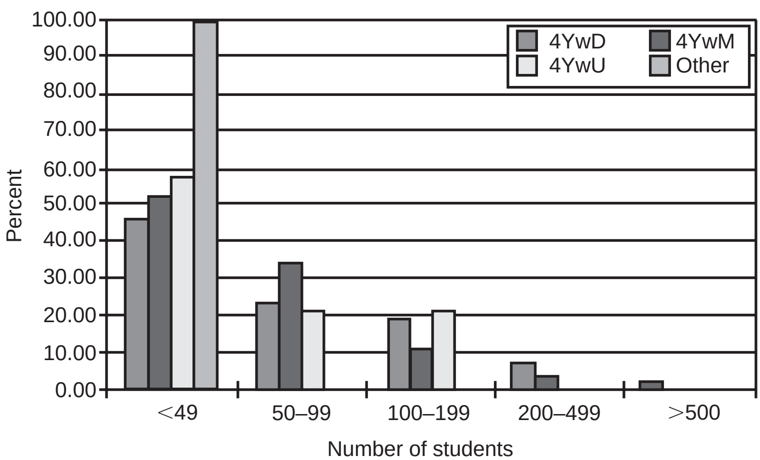

Figure 1. The size of graduating class of IS undergraduates

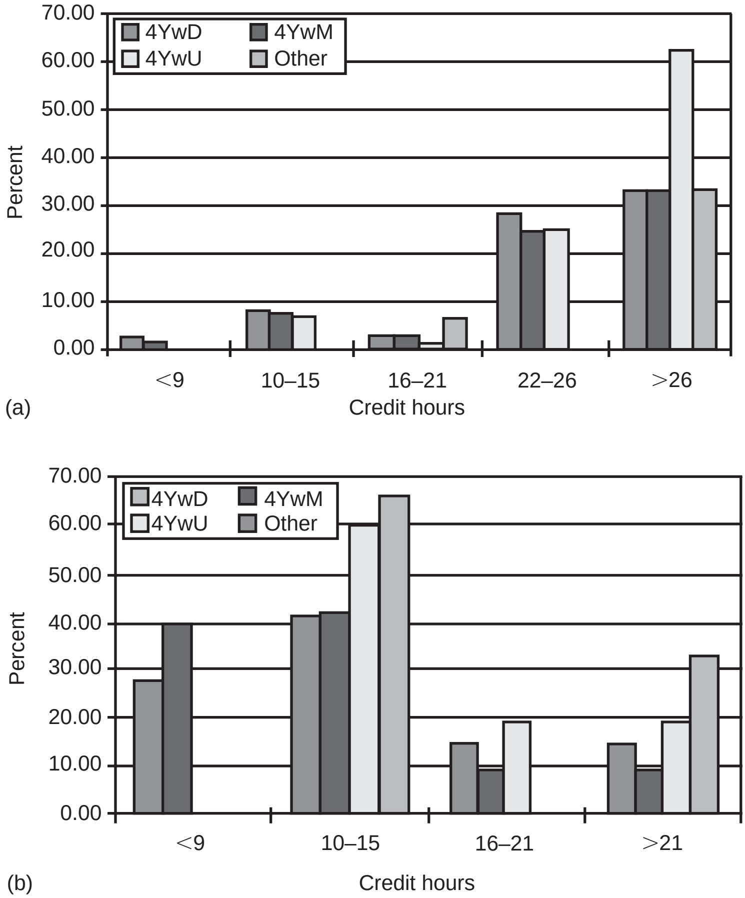

Figure 2. Credits required for IS graduates: (a) undergraduate and (b) MBA with IS track

undergraduate degree, students in most of the institutions (over 79%) must complete at least 22 credit hours of IS courses. A significant number of institutions (over 36%) require more than 26 credit hours for the degree. For MBA students who want to specialize in IS, the credit requirement is much relaxed. About half of all institutions require only 10–15 credit hours of IS courses. There are even a significant number of the institutions (about 30%) requiring less than 9 credit hours for such an MBA degree, representing less than 30% of the total credit requirement for an MBA degree at most accredited institutions.

Faculty

The quality of any educational programme is largely dependent on the quality of its faculty. Unfortunately there are no commonly accepted and well defined criteria for measuring such quality. If the tenure status and percentage of faculty who hold terminal degrees can be considered as two of these criteria, then the quality of current IS faculty as a whole is quite impressive. Of all the respondents, more than 68%

had tenure, and 90% had terminal degrees. Only about 8% of the faculty had no terminal degrees. In terms of institution types, four-year graduate degree granting institutions (4YwD and 4YwM) had significantly higher percentages of both tenured faculty (69 and 72%) and terminal degrees (92 and 91%) than undergraduate institutions (4YwU) (56 and 76%, respectively). However, it is interesting to note that the undergraduate institutions had a significantly higher percentage of tenure earning faculty (36%) than the graduate degree granting institutions (21 and 19%). This suggests that undergraduate institutions are growing at a faster pace because most newly hired faculty usually fall into the tenure-earning category (see Table 4 for details).

Being an applied academic discipline, IS teaching curricula are closely related to the real world issues in both technical and managerial contents. Thus, knowledge and experience in the real world IS is likely to enhance teaching effectiveness. Another potential indicator of faculty quality would therefore be IS related non-academic employment experience. Table 5 shows the statistics of academic and professional experience of IS faculty.

It can be seen that except for the 'other' category, whose sample size is too small to be comparable, IS faculty in the other three categories of institutions are almost the same in terms of their academic and professional experiences. An average faculty member has been in faculty positions for 11–13 years, and has about 6–8 years' IS related non-academic employment experience. However, the large variances of the averages need to be acknowledged. In fact, about one-third of all faculty members surveyed had no prior IS related non-academic experience, and about 11–20% lacked any non-academic employment experience whatsoever, a situation most prevalent at undergraduate institutions. Combined with the fact that undergraduate institutions are the fastest growing segment of IS education, the implication would seem to be that newly hired IS faculty members are increasingly arriving at their institutions with little or no non-academic experience. The effect of this trend on the quality of the IS programmes is not clear and certainly warrants future investigation.

Table 4. Faculty tenure and degree status[a]

	Tenure						Degree			
	Tenured		Tenure-earning		Non-tenure		Terminal		Non-terminal	
Institution[b]	No.	% of all	No.	% of all	No.	% of all	No.	% of all	No.	% of all
4YwD	81	69.23	24	20.51	10	8.55	108	92.31	7	5.98
4YwM	65	72.22	17	18.89	7	7.78	82	91.11	7	7.78
4YwU	14	56.00	9	36.00	2	8.00	19	76.00	4	16.00
Other	4	50.00	1	12.50	3	37.50	7	87.50	1	12.50
Overall	164	68.33	51	21.25	22	9.17	216	90.00	19	7.92

[a]Percentages are computed within institution types, except for the category for 'All' institutions.
[b]4YwD, 4YwM and 4YwU represent four-year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.

Table 5. Faculty professional and academic experience

Institution type[a]	Years on faculty[b]		Years of non-academic employment[b]				Faculty without full-time employment experience			
			IS related		All		IS related		All	
	μ	σ	μ	σ	μ	σ	No.	% of all	No.	% of all
4YwD	12.71	7.63	6.01	5.95	7.16	6.55	38	32.48	13	11.11
4YwM	12.82	7.64	7.43	6.34	8.57	7.09	32	35.56	14	15.56
4YwU	10.78	6.76	8.06	6.60	10.20	9.16	9	36.00	5	20.00
Other	17.85	14.09	6.40	5.95	12.29	12.13	2	25.00	1	12.50
Overall	12.73	7.82	6.77	6.19	8.15	7.31	81	33.75	33	13.75

[a]4YwD, 4YwM and 4YwU represent four-year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.
[b]μ and σ are the mean and standard deviation of the sample, respectively.

Another important aspect of IS faculty quality is technical competency in the areas they teach. To assess this competency, we adopted the competency measure for undergraduate IS programmes, proposed by Cougar *et al.* (1995), which consists of 15 educational modules measured on a five-point scale, with 0 being the lowest and 4 the highest. Each respondent was asked to rate himself or herself using this instrument. The results are shown in Table 6. One remarkable observation is that, overall, professors rated themselves the lowest, with a mean value of 2.39, associate professors rated themselves the second, with 2.62, and assistant professors rated themselves the highest, with 2.75. This may be the reflection of the fact that most of the junior faculty members graduated with a terminal degree more closely related to information systems, while a larger proportion of the senior faculty members have degrees outside of IT related areas.

Interestingly, the self-rated competence in the module 'utility and CASE tools' is among the lowest for faculty members of all ranks. Even though Cougar *et al.* (1995) rated this module as one of the areas that require the highest competence for IS majors, utility and CASE tools have never taken off in IS programmes. This lack of acceptance may be due both to the lack of a universally accepted CASE tool and to the cool acceptance of these tools by industry (Iivari, 1996). It is also worth noting that in the traditional core areas of information systems, such as information systems concepts, end user applications, and systems analysis and design, faculty members of all ranks have given themselves uniformly high marks.

How IS faculty allocate time to their various academic and professional activities is always an interesting question to both administrators and faculty themselves. Tables 7 and 8 may help shed some light on this question. If the faculty activities are grouped into teaching, research, services and other, then IS faculty spend roughly 60% of their time on teaching related activities, about 16% on research activities, 17% on service activities and the remaining 7% on other activities.

Table 6. Faculty technical competency[a]

Skills	Professor		Associate professor		Assistant professor		Instructor		Adjunct	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Information technology software & hardware	2.73	0.88	3.03	0.67	3.10	0.59	2.63	0.52	3.40	0.49
End user applications	3.17	0.82	3.38	0.64	3.37	0.70	3.00	0.76	3.20	0.40
Information systems concept	3.13	0.83	3.39	0.64	3.59	0.50	3.25	0.71	3.60	0.49
Procedure programming and 3GL[b]	2.36	1.17	2.58	1.17	2.84	1.05	2.75	0.71	1.80	0.40
Algorithm development and design	2.06	1.23	2.18	1.21	2.10	1.18	2.38	0.74	1.60	1.20
File structure and techniques	2.04	1.09	2.32	1.06	2.57	1.04	3.13	0.64	2.20	1.17
Utility and CASE[c] tools	1.80	1.19	2.10	1.06	2.24	1.09	2.13	1.13	1.40	0.49
Data structure: con-ventional and OOP[d]	1.94	1.01	2.26	1.03	2.33	0.92	2.50	0.53	2.20	1.17
Database technology	2.48	1.02	2.75	0.83	2.82	0.88	2.75	0.71	2.80	0.75
Data communications and network	2.15	1.04	2.28	0.91	2.53	0.84	2.75	1.28	2.60	1.20
Operating systems	2.08	0.95	2.10	0.89	2.24	0.83	2.63	0.74	2.20	0.98
Systems integration	2.08	1.04	2.26	0.98	2.29	0.74	2.38	1.19	2.80	0.98
Systems analysis, design and implement	2.79	0.93	3.11	0.83	3.29	0.76	3.00	0.53	3.20	0.75
Management of Information systems	2.73	0.95	2.96	0.90	3.29	0.82	2.63	0.92	3.60	0.49
Overall	2.39	1.10	2.62	1.03	2.75	0.98	2.71	0.83	2.61	1.10

[a] μ and σ are the mean and standard deviation of the sample, respectively.
[b] 3GL, third generation language, such as COBOL, PL/1 and C.
[c] CASE, Computer-aided software engineering.
[d] OOP, object-oriented programming.

Table 7. Faculty time allocation[a] on various activities: by institution type

	Institution type[b]							
	4YwD		4YwM		4YwU		Other	
Activities	μ	σ	μ	σ	μ	σ	μ	σ
Teaching undergraduate	26.09	18.46	33.31	23.46	48.20	24.95	12.75	18.47
Teaching graduate	14.15	14.62	8.52	10.14	6.40	10.46	15.63	14.50
Course preparation	19.68	14.91	20.76	14.90	16.80	14.21	21.25	11.57
Research	21.06	14.86	17.05	14.34	13.60	10.16	25.00	28.91
Academic service	13.27	15.85	14.23	13.72	6.60	7.74	6.88	11.00
Outside service	1.94	3.97	2.94	5.48	3.00	5.00	2.50	3.78
Outside employment (IS related)	3.15	6.60	4.10	10.64	6.20	18.27	6.25	7.91
Outside employment (non-IS related)	0.41	2.65	0.58	2.23	4.00	20.00	0.00	0.00

[a] μ and σ are the mean and standard deviation of the sample, respectively.
[b] 4YwD, 4YwM and 4YwU represent four year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.

Once again, however, large variances signify that major individual differences exist. In general, IS faculty at graduate degree granting institutions (4YwD and 4YwM) spend relatively less time on teaching activities (60 and 61%) than those at undergraduate institutions (72%). This is expected given that faculty members at undergraduate institutions usually have higher teaching loads, as is shown in Fig. 3. While the majority of IS faculty in the 4YwD and 4YwM carry weekly teaching loads of up to 11 credit hours (in most semester systems, this translates into three courses per semester), most IS faculty in undergraduate institutions usually teach up to 14 credit hours (four or more courses in semester systems). The reduced teaching load in the graduate degree granting institutions, however, is usually offset by research requirements. Faculty members in these institutions, on average, spend at least 25% more time on research than faculty in the undergraduate institutions (21 and 17 versus 14%).

Comparing these finding with those reported in the 1989 survey by Longeneker and Feinstein (1991), it is evident that while the time spent on teaching has been reduced slightly (from 66 to 61%), the time on research has been more than doubled (from 8% to an average of 20%). The changes are consistent with the perception that an increasing number of business schools are putting more weight on research when evaluating faculty performance (Im and Hartman, 1997). As long as the trend in evaluation persists, it is logical to expect the increase in emphasis on research to continue, despite frequent calls for greater focus on teaching quality at many universities and colleges.

Another interesting observation from Table 7 is that, on average, IS faculty in graduate degree granting institutions spend less than 5% of their time on outside employment versus over 10% by those in undergraduate institutions. It must be

Table 8. Faculty time allocation[a] on various activities: by academic rank

	Academic rank									
	Professor		Associate professor		Assistant professor		Instructor		Adjunct	
Activities	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
Teaching undergraduate	29.21	23.25	31.83	21.75	30.62	21.75	27.88	22.18	33.00	28.20
Teaching graduate	12.18	13.24	9.45	11.02	10.67	11.29	20.88	26.44	5.00	5.00
Course preparation	19.62	15.97	20.48	13.31	19.81	13.61	24.38	19.90	12.00	13.04
Research	18.92	16.40	17.18	11.04	25.00	16.45	6.25	7.44	2.00	4.47
Academic service	11.75	13.17	15.88	13.64	9.23	7.69	17.50	32.40	4.00	5.48
Outside service	2.01	4.37	3.32	5.74	2.17	3.55	1.25	3.54	2.00	4.47
Outside employment (IS related)	3.94	6.18	2.81	6.70	2.12	3.97	3.75	5.18	42.00	44.38
Outside employment (non-IS related)	0.59	3.13	1.62	11.48	0.29	1.54	0.63	1.77	0.00	0.00

[a] μ and σ are the mean and standard deviation of the sample, respectively.

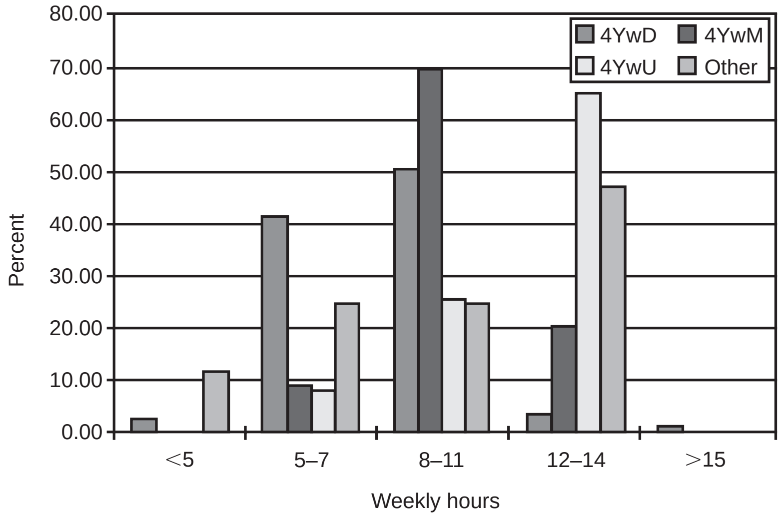

Figure 3. IS faculty teaching load

acknowledged, however, that the variances here are several times larger than the averages, indicating great differences in individual cases. In fact, most of the outside employment activities, such as consulting and contract jobs, seem to be undertaken by a small proportion of faculty members, who spend a significant amount of time on these activities.

Table 8 views the allocation of time from another perspective: by academic rank. It shows that while professors, associate professors and assistant professors spend roughly the same amount of time (60%) on teaching related activities, assistant professors spend significantly more time (25%) on research than associate professors (17%) and professors (19%). Not surprisingly, the time spent on outside employment by these three ranks is in the opposite order, with professors spending the most time (4.53%), associate professors second (4.43%), and assistant professors spending the least (2.41%).

Programme content

It is extremely difficult, if not impossible, to present a comprehensive picture of what is being taught in various IS programmes due to the great variety in objectives and programme structures. There have been, however, some attempts to assess the content of these programmes using surveys (e.g. Longenecker and Feinstein, 1991; Chen *et al.*, 1991; Shah and Martin, 1997). Although each of these surveys presented a variety of information, their principle focus appears to have been determining details related to the technical content of the curricula, such as what specific programming languages, application software, hardware and operating systems, were in use. While the current survey gathered information on the technical content of both undergraduate and graduate programmes for comparison, it also investigated a number of non-technical content areas.

With respect to the technical content, Table 9 shows that in both undergraduate and graduate programmes, a wide range of third and fourth generation languages are taught. Overall, the three most popular programming languages are COBOL, C/C++ and SQL. It also shows that COBOL is no longer the dominant language, as it had been in previous surveys (Chen *et al.*, 1991; Longeneker and Feinstein, 1992; Shah and Martin, 1997). Today C/C++ and SQL have become the primary programming languages for IS students. The popularity of the top three languages is no coincidence but a reflection of the needs of the IS job market. A study of employment advertisements by Mackowiak (1991) found that the two most frequently required languages were C (39.2%) and COBOL (20.6%), and among the advertisements for special purpose languages, the two most frequently required were CICS (33.3%) and SQL (18.5%). A recent survey of Fortune 500 companies (Zhao, 1997) also found that C/C++, COBOL and database programming languages topped the list of programming skills for business professionals.

Comparing the data in Table 9 with the findings of a 1989 survey of AACSB-Accredited business schools (Chen *et al.*, 1991) offers an interesting perspective on how programming language content has changed over the years. Among the surveyed business schools offering IS programmes, the top three languages taught were:

(1) COBOL (45%), Pascal (18%), and Basic (13%) (under the ACM curriculum); and
(2) Basic (46%), COBOL (26%), and Pascal (14%) (under the DPMA curriculum).

While COBOL still remains the most popular language taught by IS programmes today, the percentages of IS programmes offering C++ and SQL have shown a significant rise. They were not even on the list of both ACM (Association for computing machinery) and DPMA (Data Processing Management association) curricula for IS programmes in 1989. Widespread business use of Windows and relational database applications over the last decade has undoubtedly been the major contributor to this trend. The continued strong showing of COBOL language may be attributed to two major factors: the large installed base of mainframe shops with mostly COBOL applications and the 'Year 2000 problem' that has created a surge in demand for skilled COBOL programmers.

With respect to language content, a clear distinction can be drawn between undergraduate and graduate programmes: while at least two-thirds of the undergraduate programmes teach these languages, less than half of the graduate programmes do so. The implication is that graduate programmes tend to have a greater emphasis on management oriented issues than undergraduate programmes, a fact supported by the strong (and growing) emphasis on case studies in graduate programmes (see Tables 10 and 11 for the top ten).

In order to assess the content of IS programmes, questions from the skills questionnaire devised by Lee *et al.*, (1995) were adopted, supplemented both by a series of case-study related questions and by a number of questions related to areas of specific interest to the authors (including the Internet, client–server applications development, and ethical issues in IS). In total, 40 questions were used to assess the

Table 9. Program languages taught[a]

	Undergraduate programmes[b]						Graduate programmes[b]			
	4YwD		4YwM		4YwU		4YwD		4YwM	
Language	No.	%	No.	%	No.	%	No.	%	No.	%
COBOL	44	77.19	40	80.00	8	57.14	9	32.14	7	41.18
C++	44	77.19	30	60.00	12	85.71	13	46.43	4	23.53
SQL	40	70.18	26	52.00	11	78.57	15	53.57	7	41.18
C	30	52.63	23	46.00	5	35.71	7	25.00	5	29.41
Basic/Visual Basic	28	49.12	15	30.00	5	35.71	6	21.43	3	17.65
Other[c]	18	31.58	14	28.00	4	28.57	5	17.86	4	23.53
DBASE/xBASE	11	19.30	12	24.00	2	14.29	5	17.86	2	11.76
Pascal	11	19.30	8	16.00	1	7.14	4	14.29	1	5.88
RPG	6	8.77	4	12.00	1	7.14	0	0.00	0	0.00
Assembler	5	10.53	6	8.00	0	0.00	2	7.14	0	0.00
FORTRAN	4	7.02	5	10.00	0	0.00	0	0.00	1	5.88
PL/1	0	0.00	0	0.00	0	0.00	1	3.57	0	0.00

[a]Responses are limited to one per institution, and %s are calculated within each institution type.
[b]4YwD, 4YwM and 4YwU represent four year colleges/universities with the highest degree offered being doctoral, Master's and Bachelor's, respectively.
[c]Other, includes any language that is not in the list.

Table 10. The top and bottom ten contents in IS curricula

Rank	Undergraduate programme	Graduate programme
Top		
1	Relational database	Internet technologies and usage
2	Systems analysis–structured analysis	Telecommunications
3	Data management (e.g. data modelling)	Relational database
4	Telecommunications	Computer networking
5	Computer networking	Case studies of IS situations, emphasizing emerging technologies
6	Internet technologies and usage	Case studies of IS situations, emphasizing corporate strategies
7	Client–server application development	Data management (e.g. data modelling)
8	End user application development (e.g. spreadsheets, DBMS[a])	Strategic application of IT
9	Programming in at least one 3GL[b]	Emerging information technologies
10	Case studies of IS situations, emphasizing systems implementation issues	Case studies of IS situation (any)
Bottom		
31	Ethical issues in IS	Managing the information resources
32	Group support software (e.g. GDSS[c], Lotus Notes)	Case studies of IS situation, emphasizing marketing issues
33	Expert systems–artificial intelligence	MS Windows application development
34	Organizational and human resource impact of IT	Ethical issues in IS
35	Case studies of IS situation, emphasizing OB–HRM[d] issues	Minicomputer operating systems
36	Case studies of IS situation, emphasizing marketing issues	Computer hardware
37	Marketing using IT	COBOL programming
38	Minicomputer operating systems	Minicomputer operating systems
39	Mainframe operating systems	Mainframe operating systems
40	Assembly language	Assembly language

[a]DBMS, data base management system.
[b]3GL, third generation language, such as COBOL, PL/1 and C.
[c]GDSS, group decision support systems.
[d]OB/HRM, organizational behaviour and human resources management.

general content of IS programmes. Respondents were asked to rate their IS programmes for each content area using a scale of 0 to 6, for both the present and five years ago. To minimize bias and improve the reliability of responses, the scales were anchored by providing detailed description for each value. Based on the responses to these questions, the current ten most and least important content areas for IS programmes were identified using the mean value of the responses for each of the 40 content areas. The results are presented in Table 10. Those ten areas experiencing the greatest increase and decrease in ranks over the past five years were also identified. The results are presented in Table 11.

Table 11. The top ten rank increases and decreases over five years

Rank	Undergraduate programme	Graduate programme
Increases		
1	Internet technologies and usage	Internet technologies and usage
2	Computer networking	Client–server application development
3	Client–server application development	Emerging information technologies
4	Windows application development	Computer networking
5	Distributed processing	Systems integration
6	Fourth generation languages	Distributed processing
7	Case studies of IS situation, emphasizing emerging technologies	Case studies of IS situation, emphasizing OB–HRM[a] issues
8	Telecommunications	Case studies of IS situation, emphasizing ethical issues
9	Emerging information technologies	Case studies of IS situation, emphasizing corporate strategies
10	Case studies of IS situation, emphasizing ethical issues	Case studies of IS situation, emphasizing general management issues
Decreases		
1	Mainframe operating systems	COBOL programming
2	COBOL programming	Programming in at least one 3GL
3	Computer hardware	Systems analysis and design
4	Decision support systems	Managing IS implementation
5	Expert systems–artificial intelligence	Expert systems–artificial intelligence
6	Assembly language	Mainframe operating systems
7	Case studies of IS situation, emphasizing project management	Computer hardware
8	Microcomputer operating systems	Decision support systems
9	Managing the information resource	Structured programming–CASE[c] methods and tools
10	Programming in at least one 3GL[b]	Case studies of IS situations (any)

[a]OB–HRM, organizational behaviour and human resources management
[b]3GL, third generation language, such as COBOL, PL/1 and C.
[c]CASE, computer aided software engineering.

Two results are obvious from these rankings: that IS programmes have undergone a transformation over the last five years, and that undergraduate and graduate programmes are quite different in their emphases. The changes are clearly demonstrated by Table 10: both undergraduate and graduate IS programmes have been moving away from the traditional text-based, centralized and mainframe dominated environment to the graphical, distributed and client–server architecture. The Internet content area has become particularly popular in both programmes. COBOL programming, computer hardware, decision support systems, and expert systems–artificial intelligence are among the ten areas experiencing the greatest drop in importance for both undergraduate and graduate IS programmes. These changes generally reflect the state of art of IT in the corporate world where decentralization, client–server and the Internet technology have rapidly increased in importance over the last five years. The results also indicate that the IS programmes are highly dynamic in content and appear to be responsive to emerging trends in the real world.

Table 10 also highlights some important differences between undergraduate and graduate IS programmes. While the undergraduate programmes still consider application development skills, such as relational database, systems analysis and design, user application development, and programming languages, as core content areas, graduate programmes place more emphasis on emerging technologies and case oriented teaching of these technologies and the related management issues. It is reasonable to infer that in general, the undergraduate IS programmes are more devoted towards the goal of educating IS professionals with desirable technical skills while graduate IS programmes are more focused on educating IS professionals with desirable managerial skills.

CONCLUSIONS

The results of the survey of IS faculty suggest a number of trends in the IS education programmes: IS programmes are increasingly popular in the USA higher education institutions; IS faculty are spending more time on research while teaching load has been held steady, and having increasingly impressive academic credentials; the content of IS programmes has changed dramatically over time, apparently in response to the changes in information technologies; and undergraduate and graduate programmes, while sharing many common characteristics, seem to place different priorities on technical and managerial content.

Although these findings relate strictly to the IS education programmes in the USA, they are also relevant to the international IS education community. In fact, these results may prove useful from two entirely different perspectives. First, given that IT usage has achieved a higher level of penetration in the USA than in any other major industrial country, these findings may be viewed as a roadmap for IS programmes of the future outside the USA. From an entirely different perspective, it can also be argued that because the history of IS in the USA differs dramatically from that of other countries – particularly developing nations – it may prove that changes in content, rather than the content itself, being experienced by the USA programmes, could be of greatest interest. One cannot look at the USA programmes without acknowledging the role played by the large, mainframe based 3GL systems in defining the nature of IS education. Many countries today, however, are making the transition into the information age without the traditions associated with such large systems, or the need to maintain the legacy software. In the absence of such traditions, the appropriate design for IS higher education is likely to differ radically from the USA model. Nonetheless, the direction that USA programmes are taking, as they try to move away from these traditions, should be of considerable interest to IS educators around the world.

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