Research

The ten most valuable components of an information systems education

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Abstract

Information Systems curriculum matters are receiving a great deal of attention as academia and industry attempt to keep abreast of rapid changes in computing technology. The DPMA and the ACM have recently revised their curriculum models to reflect these changes and many IS programs will follow in their footsteps, so that IS professionals will be able to meet future organizational needs. In an attempt to identify curriculum components which can be considered valuable, this study is directed at IS professionals who have successfully completed a technical course of study in IS and are currently employed as IS professionals in the business world. The goal was to find out what they deemed important in their IS education. The input from professionals is revealing, countering many of the claims about the decrease in demand for technical expertise and skills in information systems.

Key words: IS careers; IS curriculum; DPMA; ACM; IS practitioner; IS skills

1. Introduction

Maintaining an effective, up-to-date curriculum in Information Systems at the college and university level is a major challenge. Changes are occurring everywhere. Hardware and software advances have greatly affected the nature of business computing through the years and procedures are being developed to adapt to new telecommunication technologies. Business organizations are searching for IS graduates with both computing and business communication skills who also understand management, the organizational purpose, and have a corporate perspective. The challenge facing academics is twofold: (1) keep the IS program up to date and (2) ensure graduates understand business as well as computing – a formidable task.

Recognizing the need for an updated curriculum, the Curriculum Task Force 1990's of the Data Processing Management Association entered into a project to revise its model curriculum. The effort resulted in “A DPMA Model Curriculum for Undergraduate Computer Information Systems” [2]. That report states, “Revisions of the Information Systems curriculum have been driven by technology” and cites factors mandating an updated curriculum:
- significant technological advances,
- the increasing criticality of IS in organizations of all sizes.

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new, more important roles for the IS executive, and
redefinition of IS as being a means to achieve organizational goals.

The new curriculum model places more emphasis on "graduates who can communicate effectively, continue to update their skills, and be confident in their abilities as professionals." Curriculum soul-searching seems to be going on at many universities which, like the DPMA, think that modifications are needed. Igbaria, Greenhaus, and Parasuraman [6] published the results of a study on career orientations of MIS employees in which job satisfaction, commitment, and retention were studied as functions of compatibility with their career orientation and job role. Their most significant finding was that employees whose career orientations were compatible with their job setting reported high job satisfaction, high career satisfaction, strong commitment to their organization, and low intentions to leave the organization.

In a study at Eastern Washington University, Reitsch and Nelson [12] surveyed both employers and graduates on IS program expectations. Findings indicate that employers want good communication skills, good analysis and design skills, but only programming and data processing skills sufficient to facilitate the training programs provided by the company. MIS graduates felt that a strong technical background which included additional languages enhanced their entry position and that while broader business training is desirable for the long run, it does not help in finding a job. Reitsch and Nelson state that this disparity leads to a conflict between the near-term and long-term needs of the student and impacts planning in the IS program. The challenge is to provide for the immediate needs of the graduate and to provide the basic business skills needed to succeed in a corporate role beyond the entry level.

Little and Margetson [8] addressed the problem of integrating technical skills within their organizational and social context. They found group-based project work to be vital in helping to develop interpersonal and interaction skills and concluded that "the graduate who is to perform well in this kind of situation needs to know both about these matters and how to function effectively within their framework." Little and Margetson contend that the group systems project goes a long way toward accomplishing that goal.

At California State University, Long Beach, Khan and Kukalis [7] studied the relationship that may exist between the education of IS professionals and job performance. They found that "both MIS managers and non-managers agree that nontechnical skills are more important than technical skills for higher professional advancement" but conceded that certain areas of MIS require technical skills. The study showed that 20%-30% of MIS professionals do not have a degree in IS and that adequate training may prove to be an effective substitute for a formal MIS education.

A group of researchers from the University of Georgia led by Hugh Watson [14] conducted a study using Collaborative Workstation Software to survey members of the UGA advisory board as to the skills expected of new MIS hires. They found that MIS positions are no longer limited to
"techies" and that MIS positions are demanding business knowledge, communication, and interpersonal skills. Demand is now shifting toward hiring employees with the ability to communicate as well as to perform the technical tasks associated with the IS position.

Other studies [1,5,10,11,16] add weight to the argument that certain technical areas in IS are declining while there is a strong surge of attention being paid to managerial and human factor skills among IS professionals. Few studies present technical aspects as an issue but Thom Lute [9] of Ohio State has questioned whether MIS/CIS graduates are getting the technical training they need. His research looked at coverage of technical topics in IS textbooks and raised questions on the depth of some topics. The article did not raise any issues as to the appropriateness of technical training and had little impact on the traditional IS major since Lute confined his assessment to introductory courses.

The debate continues over technical factors, which some assert can be learned in a training program and human factors, which some assert are the true purpose of an education. The task facing the IS curriculum designer is to achieve an appropriate balance between providing technical skills for entry level positions and providing an organizational viewpoint of IS that can lead to long-term career advancement.

2. Purpose of the study and methodology

Most of the recent IS curriculum literature has concluded that the need for technical IS skills is decreasing while the demand for managerial and human factor skills is increasing. Although managerial skills are needed by executives, including IS professionals, and human factors are the heart of the business enterprise, technical skills are also an important part in achieving the goals of the corporation and are extremely valuable to both the corporation and the employee. One goal of our study was to find out if practitioners perceive an imbalance between the technical and managerial aspects of their education. Discovery of an imbalance could indicate a need for curriculum modification.

An opportunity to study these questions arose when data was made available from a nineteen ninety-one survey of practitioners who graduated from an undergraduate information systems program in a large, diverse metropolitan area [13]. Many of the practitioners are employed by companies which are technical leaders in the use of information systems. In addition to demographic questions about their jobs roles and experience, practitioners were asked several open-ended questions about their educational experience. Our study focuses in on the components deemed most valuable in their education and the components deemed least valuable, given their employment experience since graduation. The responses are suitable for categorization and analysis and over one hundred respondents provided input on perceived value of curriculum components. This article describes the methods used for analysis and presents the results. Given the flavor of recent IS curriculum studies, the results are somewhat surprising.

The contextual approach to analyzing open-ended responses suggested by Weisberg and Bowen [15], was used to create categories from the responses (Appendix A). Upon receipt of the response forms, the answers to the open-ended questions were transcribed into electronic format for further processing and analysis. The frequency of the responses for each category was then tallied and cross-checked for accuracy. The questions on relative value conform to the "liked best/liked least" scenario described by Fink and Kosecoff [3] and provide for ranking analysis by response, response pattern, and response summary. This type of data gathering and analysis was chosen to give respondents the widest response latitude. The open-ended responses, in which respondents answered questions in their own words, provide an excellent idea as to what the respondents actually think and feel (Appendix B).

3. A profile of the respondents

Before examining survey results, a respondent profile is appropriate. All respondents followed a
homogenous course of study beyond what might be considered basic computer literacy. Courses were rigorous and highly technical with a primary emphasis on the production aspects of business computing and a secondary focus on business management. Graduates received intensive instruction and hands-on practice in the hardware and software environments they were expected to encounter in jobs after graduation, in addition to thorough course of study in business administration.

Approximately eighty-five percent of the respondents graduated after nineteen eighty-four, providing a relatively “late-model” group. Of the remaining fifteen percent, the respondent with the earliest graduation date was one who completed the program in nineteen seventy-two. After graduation, sixty percent of all respondents obtained jobs as Cobol programmers in large companies including major electronics firms with technically advanced information systems departments, defense contractors, and energy companies. The average beginning salary was $25,000 per year and those with five to six years of experience reported making an average of almost $45,000 per year. Many have gone to higher levels in the organizations. Additional details about the respondents are available from the authors.

Demographics seem to indicate that respondents are successful as IS professionals and are cognizant of the business environment. They have strong opinions about important and unimportant components of their educational experience. Their knowledge and experience lend credibility to responses since most have advanced beyond entry level positions to higher levels in the organizations. Many are managers involved in the recruitment process for the firms.

4. Most valuable components

4.1. Number 1: structured programming and Cobol

Since sixty percent of the respondents reported being involved with Cobol and business programming, the fact that programming and the Cobol language are highly valuable is not surprising. What is surprising is the strength of the support and their recommendations for the future. IS practitioners realize that there are seventy billion lines of Cobol code in existence [4] and that Cobol programming will be needed far into the future. They have seen how Cobol interacts with DBMS products for information retrieval purposes, and they have seen the continuing effectiveness of Cobol as the predominant business language, even in sophisticated IS shops.

Respondents also see Cobol as a way to develop logic to accomplish informational goals. Some respondents, particularly those who did not go on to Cobol programming jobs, saw less value in learning Cobol than those who did go on to Cobol jobs. It was generally felt that Cobol is not the only thing to learn, even in the IS curriculum, but that Cobol is a valuable curriculum component. Respondents indicated that Cobol training is of great value to them as business programmers. From the data on salaries and mobility within the organization, Cobol has certainly not hindered them. On the contrary, many who obtained first jobs in Cobol programming have advanced to managers, supervisors, and middle to upper level executives. Cobol is important to their careers.

4.2. Number two: technical aspects of computing

The course of study these graduates went through can be considered highly technical since the primary intent was to teach them how to use the computer in business computing. Respondents were required to write programs, build systems, read core dumps, program in assembler, create data structures, and analyze and design systems using CASE. They reported the technical aspects of computing were highly valuable. That is not to say that they deem managerial issues unimportant, but that they believe the technical aspects of computing are highly valuable in performing the tasks required by their jobs. Respondents use the technical skills obtained from the long hours poring over hexadecimal code and debugging errors in programs, and the technical aspects of computing continue to be valuable for IS professionals.
4.3. **Number three: systems analysis and development**

Respondents selected systems work as the third most valuable component of their educational experience. They had explored systems theory and application including analysis, design, development, and implementation of a working system using a CASE tool. Systems courses provided a framework in which to apply programming and technical skills. Respondents know that there is more to computing than just programming.

Respondents have been involved primarily with mainframe systems in both their educational experience and work roles. Large, complex systems require more than programming skills, and experience with system development techniques and tools make them more productive and effective. These skills enable them to apply computing skills in a structure of systems design that addresses the problems associated with complex systems in computing and other enterprise areas.

4.4. **Number four: general business**

In addition to a high regard for the technical aspects of their education, respondents see benefits in general business education and non-IS courses. Specifically, business writing skills, general business topics, and specific non-IS courses are valuable. Responses tend to support the idea that technical aspects should be balanced with other aspects of the IS education and that the business environment is very important to IS careers. Just providing them with a technical education is not enough. Respondents report a need to understand the business in which they apply their technical skills.

4.5. **Number five: education / experience with relational database systems**

In-depth, production-oriented training and experience with relational database systems is also important. Two themes are apparent in the responses. The first stems from the fact that practically all large corporations are moving into relational database systems both stand-alone systems and systems that interface with, and sometimes incorporate, older Cobol applications. Respondents are particularly interested in the ability to make database calls from Cobol programs and present the resulting information using sophisticated report-generation features provided by Cobol. They also need to generate suitable user interfaces to the database for regular reporting and ad hoc queries.

The second theme is that the database environments available for classroom education are usually not as advanced as those in corporations. Few truly relational database environments which provide ad hoc query capabilities and effective user interfaces are available for educational purposes, although modern mainframe database management systems such as IMS/DB2, Focus, or others are installed in the corporate environment. Many respondents indicated that the lack of modern mainframe database processing capabilities was the most serious problem found during their studies.

In going through the responses, the authors were struck by the consistency and regularity of the responses about database topics. Virtually all the comments urged an emphasis on current database processing and environment. There can be no doubt that the respondents see the database area as crucial to the IS curriculum and that educational and experience in modern, relational environments is critical for success as an IS professional.

The new DPMA model curriculum seems to de-emphasize the database topic by combining it with systems courses. “No longer will there be a course in database and a separate analysis and design course. These topics have always been strongly coupled, and therefore, should be taught together” [2]. The survey respondents seem to disagree with this approach. If anything, respondents want more, not less, database experience, including relational models. The typical mainframe database application is complex and deserves coverage in even greater depth than now. At least for mainframe programs, combining the database course with the systems courses was not recommended by the respondents.
4.6. Number six: IS program; rigor

The technical IS program is extensive and sometimes exhausting. Students are challenged to go beyond themselves to develop the acute skills needed not only to survive in the business world but also to succeed. Many students do not make it through the course of study, finding the thoroughness and rigor of the program to be too much. Those who do make it through this type of program are, however, usually successful in their careers. Aspiring IS professionals must be willing and able to set aside many hours per week for IS courses and projects during their preparatory experience. Successful graduates find the rigor and comprehensiveness of the program valuable. Overall, respondents seem to think that the technical rigor of the IS program leads to the success experienced after graduation.

4.7. Number seven: Job Control Language (JCL)

Graduates who find themselves in a mainframe Cobol programming job need a thorough knowledge of Job Control Language to be highly productive in job tasks. This is reflected by the survey respondents who include JCL as one of the “top ten” most valuable components of their education. Knowing Cobol only is of little benefit to the mainframe programmer without expertise in the language that allocates devices and other resources to the Cobol programming job stream. The utilities and other routines available through JCL are very important. While IS professionals not involved with mainframe Cobol may find JCL training of little value, mainframe programmers are virtually lost if they do not have JCL knowledge.

There seems to be some variance in the quantity/quality of the JCL experience for the respondents. Some praise intense JCL work. Others ask for more. JCL is valuable and important to many of the students and should not be overlooked in the IS program. In fact, it seems to be counterproductive to spend a great deal of time in Cobol without equal emphasis on JCL to “make the programs run.”

4.8. Number eight: hands-on /real-world experience

According to respondents, the IS program should emphasize hands-on, real-world experience and the practical aspects of business computing. Course projects should be taken from real world settings whenever possible. Internships during the course of study and cooperative education should be stressed so that the graduate can offer an employer actual work experience that demonstrates an ability to work successfully in an organization and be productive in a computing career. Practical experience is seen as a criterion for employment and graduates who have such experience, even on a part-time basis, are very attractive to employers.

It is probably true that respondents who praised cooperative education participated in the program. Of course, many students do not, preferring to get through the course work as early as possible. However, real world experience is valuable to those who have it. Hands-on experience is universally applauded by respondents because they have realized that thorough involvement is needed to really learn about computing.

4.9. Number nine: PC environment

One of the strongest themes in the comments was the PC. Respondents are using PC’s in growing numbers and perceive a need to have more PC knowledge. Many started with terminals as an interface to the host computer. Now, most use PC’s in their jobs, rather than a terminal. PC’s are used off- and on-line as remote processors and host interfaces. The PC with memory and processing capabilities is far more intricate than a terminal comprised of only a keyboard and a monitor. Respondents are interested in learning more about the PC.

Many of the responses regarding PC’s are the result of respondents’ pursuing a mainframe course of study. Most used terminals in the computer labs. Indeed, only a few short years ago, most institutions of higher education could offer only a few PC’s for student use. That situation has changed. With the ever-increasing speed and
capacity of the PC, along with constantly decreasing prices, the PC is becoming a vital necessity for business computing. The attention given to PC's by respondents indicates the importance of education in the technical aspects of microcomputer systems.

4.10. Number ten: team/group projects

One observation that must be deemed true is that business organizations normally work with teams; i.e., more than one person. To achieve synergy and economies of scale, IS professionals regularly work together on larger organizational systems. Theories of interpersonal dynamics can be taught in the classroom but practical cooperation at the individual level is an art that must be learned by experience.

Working with team members whose schedules, interests, and abilities might vary widely, can be frustrating and time-consuming. Inevitably, team members have to deal with over-productive and energetic members as well as less-productive and less-energetic members to accomplish team goals. Many students do not like the team approach, preferring to “do it themselves.” After graduation, the value of team experience is apparent. In-class teams can prove to be a valuable learning experience and preparation for a “real world” organization. IS professionals who have mastered team dynamics of group projects are far ahead of their peers who have not.

The respondents realize that there is more to working in groups than is first suspected. They know that more can be accomplished with people working together. Participating in a team reveals that there are personality, experience, and ability differences that must be dealt with among group members. How to deal with the differences is the main purpose of the group project.

5. Other components mentioned

In addition to these, several others valuable educational components were mentioned. Variety and multiple platforms did not make the “top ten” but were close. For contemporary computing employment opportunities, the IS professional is frequently required to be familiar with several different types of environments. The recent trend from terminals to intelligent remote processors, especially the PC, requires the systems professional to use several hardware platforms and operating environments to accomplish job goals. Computing professionals need to be familiar with the integration of mainframe and PC capabilities to achieve maximum efficiency in the development process and production. IS professionals need the flexibility that knowledge of varying environments can provide including uploading/downloading, user interfaces, and maximization of efficiency of host processors as data storage/retrieval functions coupled with remote access to data and processes. Knowledge of networking and data communications is also necessary.

Communication skills were mentioned by several respondents. The comments refer to oral and written communications skills not data communications and networks. Cooperative education and internships aid in their education and employment prospects. Other components include exposure to networks and data communications, maintaining current technology and state-of-the-art environments and techniques, and information resource centers.

6. Summary

The comments and frequency rankings reveal that our respondents find Cobol programming and technical training highly valuable educational experiences. They also find systems work, database experience, and knowledge of business functions critical to IS job success. Rigorous courses, JCL, the PC environment and hands-on, real-world experience are also valuable. People skills learned in group projects and exposure to a variety of hardware and software environments is important. Communication skills and state of the art techniques are of somewhat lesser value. Results deviate from much of the recently published journal material, but there are major implications for the IS program in these rankings and comments.
7. Some comments on the “least valuable” components

Data was also collected on perceptions of least valuable components. There were surprises; e.g., although general business was cited as being the fourth most valuable component, general business was also most frequently cited as the least valuable component. To try to understand the reasons for this discrepancy, further analysis was undertaken. Respondents who indicated that general business was valuable were separated from those who indicated the converse and the two groups were compared. It was suspected that one group might be more mature in their careers or that their roles might be different. This was not the case. Respondents who thought that general business courses were most valuable were, on the average, one year behind those who indicated that general business was least valuable. Also, job descriptions and salary averages were almost identical as were their hardware and software environments. For all practical purposes, the two groups seem to be demographically identical! Several respondents indicated that purely lecture/theory courses were least valuable and their database course work was less than optimal due to the differences in past and current database environments. Several respondents, who did not go into programming jobs, saw little value in the technical aspects and Cobol programming, while several supported using current environments and greater PC exposure. Several also wanted more JCL (no one wanted less), more hands-on and real-world experience, and more language variety.

In general, the “least valuable” comments track well with the “most valuable” comments and reflect a desire for more technical exposure and less non-IS and purely lecture/theory activity. Respondents want to have technical skills that contribute to business success.

8. A glaring omission

While analysis of responses contains some interesting comments, one glaring omission is computer aided systems engineering (CASE). In fact, CASE is hardly mentioned in the written responses. Apparently, respondents either do not know CASE (a far-fetched assumption) or they are not using CASE tools in any significant way. A previous study by Pelley indicates that most organizations are evaluating, but have not implemented CASE tools [11]. Its relative newness, the difficulty of evaluating it, the high initial expense, and the mixed results that have been produced using CASE may be reflected in the comments.

9. Conclusions

This article has presented information from written comments of IS practitioners in a formal study regarding the most valuable educational components relative to careers and jobs in the computing industry. The common thread was that all completed a rigorous, technical IS education. Several valuable educational components were reported. Cobol, technical training, PC hardware and software, systems A and D, database, and hands-on experience were extremely valuable. The internship/cooperative education program received high praise. Respondents in Cobol programming jobs liked the Cobol, mainframe, and JCL topics but preferred more variety in IS course offerings.

Generally, a high value was placed on team projects, the use of current technologies, and data communications and networks. Surprisingly, very few cited CASE technology as important. The respondents indicated a strong demand for Cobol and technical IS expertise to support the IS career. The need for people skills and an understanding of the IS function in the business enterprise is required as a corollary to a strong technical background. Respondents seem to disagree with the DPMA plan to de-emphasize database and, in fact, want more database experience, especially in relational models. Computing is the use of tools to accomplish organizational goals and tasks. IS professionals must have job tools and communication and interpersonal skills. Acquiring technical skills is the first step in the process. IS professionals must know how to inte-
Appendix A

100-199 Most Valuable Component
200-299 Least Valuable Component

Specific Codes - 100-199 - Most Valuable Component
100 Systems A and D; Analytical skills
101 General Bus.; IS as Business Function; Writing; Bus. Courses (non-IS)
102 Technical Aspects; Training; Background; Course; Assembler
103 JCL
104 Cobol; Programming; Structured Programming; Mainframe; Software
105 Hands-on; Real-world; Practical approach; On-the-job
106 Variety; Diversity; More than one environment
107 Current/New technology; State of the art
108 Team/Group Projects
109 PC; Mini; More; Exposure to; Intro to
110 Database
111 Co-op; Intern Program
112 CASE
113 Communications; Communication Skills
114 IS Program; Rigor; All Aspects; Whole Program; Curriculum; Faculty; Quality; Counselors; CISO (IS Student Organization); Getting degree
115 Networks; LAN; Data Communications
116 Information Resource Management; Information Centers
199 No response for “most valuable” but responded to another question

Specific Codes - 200-299 - Least Valuable Component
200 Systems A and D
201 General Business/Non-IS Courses; Math, PE, Stats, Fin., Policy, Intro, Management, Writing
202 Technical Aspects; Problems Course
203 JCL (Not Enough)
204 Cobol; Programming; Coding Assignments; Mainframe
205 Hands-on; Real-World (More)
206 More Variety; Another Language Besides Cobol
207 Get Current; Improve Environment
209 Lack of/No PC’s
210 Database; Data Administration
214 Nothing was least valuable; All was valuable
216 Purely Lecture/Theory Classes; Mgt. Adv. Services; Case Studies; Distributed Systems Course (Lecture)
217 More on Hardware
230 Response not appropriate
299 No response for “least valuable” but responded to another question

Specific Codes - 900-999 - Miscellaneous
900 Did Not Provide Any Written Comments
910 Other Field (ACCT, CSCI); Unable to Comment

Appendix B

Rankings of comment categories

<table>
<thead>
<tr>
<th>Most Valuable Component</th>
<th>RANK</th>
<th>CODE</th>
<th>COUNT</th>
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<td>106</td>
<td>9</td>
<td>Variety; Envs.</td>
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<td>Information Resource Centers; IRM</td>
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<td>Systems; A and D</td>
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grate IS expertise into the organization but without a grounding in the technical tools, an IS professional will not have the skills to be productive in business computing.

References


