Achieving Collaborative Gain in Computing-Focused Higher Education

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Educational Innovation

Paper Proposal

May 15, 2009
Abstract

A simple majority of undergraduates in Computer Science, Information Systems, Software Engineering or similar programs will include somewhere in a research paper assignment a statement explaining how rapidly the information technology industry continues to evolve. While these fledgling scholars might easily document the pace of new hardware or software products coming to market, related programs of study at colleges and universities do not mirror this brisk evolution in the industry for which they train their students to at least contribute, if not compete. While at the core some might argue that principles of digital computing have not changed significantly since the IBM 360, most will admit that the industry’s evolving nature requires dynamic curricular adjustment. This paper investigates whether traditional curricular and school structures prevalent in higher education foster an atmosphere of imaginative exploration of the industry to help undergraduate programs provide their students the maximum opportunity for success in the Information Technology industry.

Background

The past six decades have witnessed digital computers transition from a few installations dedicated to government needs or research, to an infusion so deep in the culture that one can hardly avoid them. From electronic mail to cell phones, cars to debit cards, Google to television on demand, most every household in the civilized world feels the imprint of the spread of technology. Prognosticators suggest the saturation will continue in ways that we cannot yet imagine. A similar trend shows in the development of computer related curriculum in higher education.

Early studies of computers typically occurred in the more traditional departments of math or physics. Computing fits wonderfully in either of these areas given the digital nature of computing theory and the physics required to translate that theory into a computational device. Eventually, though, computer sciences came into its own and became a distinct discipline, gaining full recognition and academic honor in the early 1970’s. This coincided with the birth of the Apple microcomputer (followed closely by the IBM PC) in the same decades. The personal computer introduced a new element of the information technology industry producing hardware and software targeted to the consumer, rather than to the computer scientist. This catalyst helped push the computing curriculum on campuses beyond the department of computer science.
Soon, schools of businesses introduced courses to help students understand how to integrate computing into accounting, or economics, or finance, or marketing. Schools of education offered classes on the use of personal computers in education. The sciences and fine arts began a similar integration. In a short period, business schools evolved to offer entire majors in computing focusing not on the design and understanding of how a computer works or the syntax of a language, but rather on the application of existing hardware and software to a business problem. The information systems major (or similarly named programs) became as popular in schools of business as the computer science major had become in other schools. The saturation continues as courses such as “Computers in Accounting” disappear in favor of incorporating program-specific software packages and tools in all accounting courses. Thus, while the relatively new phenomenon of computing permeates centuries-old disciplines of study like the sciences, fine arts, education and others, it has also in a relatively short span spawned discipline-specific programs of study in computing in many of these context areas. This paper addresses whether the proliferation of computer-specific programs of study in separate colleges and schools of a university best serves the faculty and students.

Problem

The two most prolific computer related programs of study in universities are computer science and information systems (or some variation on the information systems title). A quick survey of college catalogues would find the overwhelming majority of computer science programs in either the school of engineering, science, or arts and sciences. The typical information systems degree is usually housed in a school of business or commerce. Thus, the faculty and student populations study and operate independent of each other. This myopic approach, we believe, incurs a hidden cost.

According to the Oxford English Dictionary (OED), a faculty is the “whole body of Masters and Doctors, sometimes including the students, in any one of the studies, Theology, Law, Medicine, Arts.” This definition dates to the 13th century and speaks to a spirit of collaboration and cooperation among peers as they seek to understand and develop a given discipline. An increase in divisions among such groups results in an inverse potential for insight into the whole body of education experience. Unfortunately, colleagues that might have benefited from the collegial spirit of faculty not only lose this opportunity when placed in different schools, they often end by developing a spirit of enmity.
Surendran, Ehie and Somarajan (2005) speak of “turf battles” and academic “functional silos” when comparing these two faculty groups.

Not all campuses experience an antagonism between their computer science and information systems faculty. Yet, housed in different schools, they lose the opportunity for incidental collaboration which should characterize a healthy faculty. Similarly, the separation extends to the students in each major who are ultimately studying closely related disciplines. The thrust of this organization scheme fosters an unhealthy spirit of competition between groups. Whether competing for students, competing for resources, competing for attention, or any other motivation, the competition itself minimizes the positive impact that students might otherwise enjoy at such a critical stage in their transition to adulthood. Collaboration should particularly distinguish a university faculty from other groups of professionals, whether pursuing a formal research agenda or through a spontaneous tête-à-tête. Competition resulting from the (posited unnecessary) division of faculty minimizes collaboration and provides no healthy benefit in its place. The popular lines of defense for competition rest mostly on culture and misinformation. Alfie Kohn chronicles four of the most common myths regarding the benefits of competition in our culture:

The first myth is that competition is an unavoidable fact of life, part of “human nature.” Although this assumption is made casually (and without evidence), it demands a considered response; if it were true, arguments about competition’s desirability would be beside the point since there is nothing we can do about our nature. The second myth is that competition motivates us to do our best—or, in stronger form, that we would cease being productive if we did not compete. This assumption is invoked to explain everything from grades to capitalism. Third, it is sometimes asserted that contests provide the best, if not the only, way to have a good time. All the joys of play are said to hinge on competitive games. The last myth is that competition builds character, that it is good for self-confidence. (Kohn, 1992, p. 8)

Without reviewing the empirical evidence presented by Kohn to support the assertions of the detrimental impacts of competition, it should still follow that other evidence exists to indicate we have much room for improvement in educating our students beyond the high school level.

A brief scan of the literature indicates an increased sense of urgency for improving the efficacy of higher education, especially in technology and the sciences. The economy of our nation has long since crossed the threshold from manufacturing to information. Pressures from emerging economies now challenge our dominance in this critical area. We can no longer afford to spend the capital of
previous generations of inventors and thought leaders. Noted scholars from the National Research Council (Bransford, Brown, and Cocking, 2000), the American Psychological Association (1997), and other empirical studies (Baxter Magolda 1999; Boyatzis, Cowen and Kolb 1995; Keeton, Scheckely and Griggs 2002; King 2003; Light 2001; Mentkowski and Associates 2000; Zull 2002) urge administrators, scholars, and others in higher education to explore methods of boosting the learning of college students. While most educational researchers propose a method for enhancing a student’s ability to achieve learning objectives, none propose continued subdivision of faculty in related fields of study. The evidence underscores that the status quo will not suffice. To achieve meaningful gain requires an approach grounded in the fundamentals of curricular design.

**Basics of Curriculum Design**

The basic definition of curriculum has changed little since the early 17th century. The OED defines curriculum as “a regular course of study or training, as at a school or university.” Some other relevant definitions from more recent literature include:

An interrelated set of plans and experiences which a student completes under the guidance of the school. (Marsh and Stafford, 1984, p. 3)

All the planned experiences provided by the school to assist the pupils in attaining the designated learning outcomes to the best of their abilities. (Neagley and Evan, 1967)

A programme of activities (by teachers and pupils) designed so that pupils will attain so far as possible certain educational and other schooling ends or objectives. (Barrow, 1984, p. 11)

While the OED refers to a “regular course,” the other three definitions similarly address plans, planned experiences or programs of specific design. Grundy (1987, p.24) traces this approach of curriculum back to Aristotle and his consideration of different kinds of human action in *Nicomachean Ethics*. In Aristotelian terms, “the disposition which informs one kind of human action is the disposition *techne* or skill....The action in which the artisan engages is called *poietike*, in English ‘making’ action....(In the Greek all these words are represented by the term *eidos*. *Eidos* is like the English term ‘idea’ but encompasses this wider range of meanings.)” The following diagram illustrates how these terms relate to developing the plan or program that becomes a curriculum.
Grundy elaborates that the skill of the professor (*techne*) brings the idea (*eidos*) into being for the student. On the other hand, the outcome of the curriculum (*product*) is prescribed by the *eidos*. Thus, even when professors bring varying dispositions to the subject matter, from an Aristotelian perspective, the outcomes will still retain a familial form when launched by the same *eidos*. In the context of this study, the guiding *eidos* revolves around computers.

**Case for Cooperation**

The heart of the argument rests in identifying the degree to which programs in Information Systems and Computer Science differ, or conversely the extent to which their *eidos* might be considered of a class. As discussed earlier, the original four faculties at the University of Paris were Theology, Law, Medicine and the Arts. The obvious distinctions in this list leave precious little room for overlap. With the information technology age less than a century old, the opportunities for this degree of distinction have not yet developed. Whether computer science predated information systems on a given campus or the other way around, each sprung from the same seed of digital technology that has become the information technology industry.

A group of researchers explored a more empirical approach to this question, even if they came to the problem from a different direction. Reichgelt (et al) investigated whether a growing trend for a third discipline, a degree in information technology, could rationally exist on campuses that already offered degrees in computer science and information systems. While concluding their study in the affirmative, their data also underscores the related nature of the degrees in question. In specific, they studied the programs of study at twelve universities that offer all three of the computer-related degrees in question, from George Mason University and Purdue, to Macon State College and the University of
South Alabama. In studying the structure of these programs, they classified the courses that schools included in the degree programs in one of seven categories:

- Business related courses (B)
- Courses concentrating on interpersonal communication (IC)
- Software related courses (SW)
- Courses on networking, web-related technologies or databases (NWD)
- Electronics or signals (ES)
- Hardware (HW)
- Mathematics and science (MS).

Repeating this study would allow for adjusting the method in terms of course classification and would certainly expand the potential number of schools in the sample field. Even so, the results by Reichgelt and his colleagues illuminate the *eidos* of these degrees.

Among the twelve schools included in the study, the researchers ended up with a sample of eight programs each for computer science and information systems. They found no information systems programs requiring a course in electronics or signals. Otherwise, the average response for both programs required classes in each of the other areas of study. The emphasis shifts from one program to the next, yet the evidence shows that classes in software, hardware, database, and math constitute a greater part of the study for students in either program. The following table summarizes the results of this study. (Note: eliminating the Information Systems program at Capella: E-Business, which was included in the study but requires only 31 classes in business and one class in interpersonal communication, sheds truer light on this discussion.)

<table>
<thead>
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<th>Distribution of courses between average programs in CS &amp; IS</th>
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<tr>
<td>Average CS Program</td>
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<td>Average IS Program</td>
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Figure 2: Summary of the average number of 3-hour courses by program (Riechgelt, et al)

A final perspective on this discussion involves the issue of accreditation for computer science and information systems programs. While most colleges and universities obtain regional accreditation covering the entire catalogue, individual programs or schools will seek more specific or more prestigious
accreditation of their programs to demonstrate a level of excellence not reflected in the regional accreditation. For over 75 years, ABET has represented excellence in technical education on par with the ABA for law schools or the AMA for medical schools. Since 1985, ABET has also accredited programs of computer science ([www.abet.org](http://www.abet.org)). Less than a decade ago, ABET added programs in Information Systems (or similarly named programs) to its suite to foster increased levels quality in a discipline that it considers closely related to the other technology and engineering programs they deal with.

ABET does not accredit schools, but rather individual programs of study. Most deans and professors consider ABET accreditation the gold standard. Many companies and graduate schools consider an ABET accredited degree of greater value than one without that endorsement. That ABET adopted Information Systems into its technically heavy sphere underscores the relationship that IS programs should enjoy with other ABET-recognized programs. Having these programs in a single academic unit on campus would validate the relationship insinuated by the ABET accreditors.

**Case Study**

At Liberty University, the School of Business offered a degree in Information Systems (IS) while the Department of Mathematics (in the College of Arts and Sciences) offered a degree in Computer Science (CS). In the Fall of 2002, the University reorganized to bring these two degrees together into a separate unit, the Center for Computer and Information Technology (CCIT).

The CCIT continued to maintain and develop the Computer Science and Information Systems programs to more closely align them with the suggested curricula guidelines of organizations like ACM and AITP. This differentiation was important so that students were more readily able to distinguish the differences in the two programs now that they resided under the CCIT banner.

During the CS and IS programs tenure under the CCIT banner, the programs continued to mature and develop into programs that offered some collaboration between the CS and IS faculty and students. This process enabled these two programs with similar *eidos* to foster collaborations between the CS and IS faculty in a return to the spirit of the cooperation in teaching students from different disciplines but as a result of the same *eidos*.
In 2005 the joint faculty in CCIT began discussing the idea to incorporate the concepts of CS and IS along with classes in visual communications (arts) with a goal of developing a Web Technology and Design program. Since the Internet and World Wide Web have become a major part of the Digital Technology eidos, the faculty believed that this discipline would provide an appropriately distinct third course of study within the CCIT.

The results of the discussions about the web technology program included the idea that this program should also incorporate a multi-disciplinary approach to the program to foster the spirit of cooperation and collaboration that was missing in many separated digital technology programs. Therefore it was decided that the web technology program would be developed to include IS and CS, but also Web and Graphic Design elements. These three disciplines would form the backbone of the designated Web Technology and Design program (WTD).

The WTD was initiated in Fall 2005, as the third program in the CCIT. The WTD was designed to give students the opportunity to develop skills in cooperation with CS faculty, IS faculty, and Graphic Design faculty leverage the spirit of collaboration between the three disciplines. The Graphic Design (GD) curriculum was incorporated to give GD students the ability to crossover from their design emphasis and put their design education into practice in web design.

The combination of CS, IS, and GD gives students the opportunity to leverage not only the programming skills from CS, and the technology skills from IS, but also the graphic skills from GD, to design cutting edge Internet-based applications. This combination gives the students a better skill set that spans several related disciplines, thus allowing the students more opportunities after graduation.

The actual design of the WTD major is outlined below:

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
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<tbody>
<tr>
<td>CSCI</td>
<td>111 Introduction to Programming</td>
</tr>
<tr>
<td>CSCI</td>
<td>112 Advanced Programming</td>
</tr>
<tr>
<td>CMIS</td>
<td>212 Object-Oriented Programming</td>
</tr>
<tr>
<td>CSCI</td>
<td>215 Algorithms and Data Structures</td>
</tr>
<tr>
<td>MATH</td>
<td>250 Introduction to Discrete Mathematics</td>
</tr>
<tr>
<td>CMIS</td>
<td>310 Web Architecture and Development</td>
</tr>
<tr>
<td>CSCI</td>
<td>325 Database Management Systems</td>
</tr>
</tbody>
</table>
In June 2007 Liberty launched four new engineering degrees, which it placed with the CS, IS and WTD programs to create the School of Engineering and Computational Sciences (SECS). This school became the home for CS, IS, and WTD along with Electrical, Industrial & Systems, Computer, and Software Engineering programs. All seven programs in the school revolve around the focus of electronics, digital technology and systems.

Since the beginning of the SECS the WTD program has undergone several revisions in order to present the program to students with all courses and prerequisites in a logical progression leading to graduation. These revisions have resulted in the major degree courses as listed above.

Another aspect of the WTD is that students have the choice of emphasizing one of three areas of study in the major; they are Java Programming, Web Page Design, or Networking. The CMIS 312 programming course, the CMIS 410 Web Technologies course, and CMIS 430 Advanced Networking course allow the student to emphasize one of these three areas of study and potential earn industry certification to complement their baccalaureate degree. This gives the student a chance to more specialize in a particular area of Internet/Web Technology.
The results of the combination of CS, IS, Web, and GD, gives students the opportunity to experience
the type of collaboration and spirit of cooperation not often experienced in the current academic
environment. The ability to mingle with other students and professors in related fields of study provide
for a richer educational experience than found in many academic settings today.

The primary benefit of the WTD program is that students now have an emphasis on collaboration
and cooperation in the spirit of academic tradition when students were exposed to many different
disciplines in order to enhance their particular discipline upon graduation.

**Conclusion**

The benefits of combining Computer Science and Information Systems into a single academic
unit seem clear. Students benefit from working with other students in related disciplines; professors
find easier and more ad hoc opportunities for collaboration; administrators find opportunities for
savings through greater use of resources. The drawbacks from such an organization are difficult to
identify. Aligning Information Systems with the Computer Science program either in a school of science
or a school of engineering would seem to most closely represent the nature of what ABET seeks in its
role as accrediting agency. Further study in this area is possible along the lines of the Reichgelt, et al,
study. Rather than seeking to justify further delineation of new technology programs, though, a similar
construction should investigate the similarities of programs rather than the differences.
References


