Examining the Impact of a New Information Systems Program and NSF STEM Funding on Computing Enrollments

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Abstract

At the dawn of the 21st century, we began two initiatives within our undergraduate computing program: a new major in Information Systems, and NSF STEM scholarships for Computer Science majors. We will put this work in context by examining the enrollment trends for both IS and CS as found in the current literature. In addition, we will attempt to understand some of the dynamics that influence these trends. Like politicians describing a fiscal deficit, we will see a silver-lining in reporting that when the decline is not as bad as it could have been, perhaps it can viewed as a windfall. By contrasting our experienced enrollment trends with the trends reported elsewhere, we will show that both programs have had a positive impact on our institution.

Keywords: declining enrollment, information systems education, information systems curricula, IS 2002, NSF STEM, scholarships

1. THE CURRENT STATE OF COMPUTING ENROLLMENTS

Little doubt exists in the current literature that enrollments in both traditional Computer Science and Information Systems programs have been declining for most of this decade. One may investigate Computer Science enrollments at a glance through the Computing Research Association's data (Vegso 2007). According to the data of Ph.D. granting institutions surveyed by the CRA, CS undergraduate enrollments are about half of what they were in the Fall of 2000.

Although the Information Systems discipline does not have a single source for this data, there are plenty of indicators regarding undergraduate enrollments. In Louisiana, CIS enrollments dropped by 43% from 2000 to 2004 (Lomerson 2006). In Texas, the number of IS undergraduates declined by 65% from 2000 to 2005 (Shah 2006). A similar decline has been reported in Wisconsin (Fleissner 2006). In a study of IS programs affiliated with AIS or AACSB, 91.4% of respondents indicated that their IS enrollments declined (Shah 2006). Furthermore, 46% of the respondents indicated that their enrollment decline was over 40%. These studies suggest that the IS discipline has not fared any better than CS in the past several years. In fact, some would say that IS has fared much worse than CS.

Citing the trends related to enrollment decline is easy. The really tough part is determining the cause of these declines. One of the commonly cited reasons is that supply in the IT workforce was artificially inflated in the late 90s due to Y2K and the dot com boom. Offshoring is the recipient of a fair amount of blame as well. Misperceptions among students (particularly those in high school) about the nature of IT, computing and its career opportunities are also frequently cited. Another favorite is media misrepresentation and exaggeration of the bad news (e.g., offshoring) without balanced coverage of the good news (e.g., growth in the IT employment sector).

A very useful document that explores much of this is the ACM's "Globalization Report" (Aspray 2006). The document itself is as complex and varied as the nature of globalization. The authors have made a valiant attempt to unpack the economic, educational, and technological mysteries that account for offshoring. One of the more interesting and relevant statements in the report is as follows: "Despite all the publicity in the United States about jobs being lost to India and China, the size of the IT employment market in the United States today is higher than it was at the height of the dot-com boom." Given this statement, we are left with the fact that the IT sector is experiencing the declining supply of a service (educated IT workers) while the demand is increasing. The impact of this on price (i.e., starting salaries of graduates) may likely be undeniable in the future.

Another work on the topic of globalization has made a much bigger splash: Thomas Friedman's (2006) The World is Flat – A Brief History of the Twenty-First Century. Friedman's work is no doubt having a profound impact on many managers in US business. Using a very entertaining and readable style he shows how outsourcing, offshoring, and supply-chains (to name a few) are changing our world in the early part of this century. However, while reading this work I was struck by two important observations. First, Friedman is a journalist trained in the art of selling newspapers (or in this case, books). Second, Friedman does not understand the important distinctions between creating software (some would say "engineering") and manufacturing non-software products or providing services.

Often while reading The World is Flat, I had cause to reflect on past lessons that have been articulated by scholars in our profession. For example, Brooks wrote in 1975 that "men and months are interchangeable commodities only when a task can be partitioned among many workers with no communication among them, " like picking cotton, not creating software (Brooks 1975). I'm not sure that Friedman has a clear understanding of the communication difficulties presented by an IT project. More to the point is the fact that building software is hard and there is inherently no silver bullet (Brooks 1986). Understanding user requirements (especially when users themselves don't know them), corporate culture, business sector, and the personalities of co-workers are all inherent difficulties that make outsourcing (and offshoring) more difficult.

Labor arbitrage is nothing new and it will continue in the IT sector. For some organizations, offshoring allows for the more interesting and complex IT projects to be done in house. However, the perceptions created by the media are hard to contextualize for the general public. Furthermore, many companies and consultants are rethinking their strategy and plans for offshoring due to the fact that hidden costs were not accounted for in many projects. The bottom line is that enrollments in CS and IS are cyclical and the market forces that appear to influence them, in our opinion, will soon move them back toward growing numbers of undergraduate students.

2. DEVELOPMENT OF AN INTER-DISCIPLINARY INFORMATION SYSTEMS PROGRAM

During the 2001-2002 academic year, our institution began the process of designing and implementing a new degree program for Information Systems. The goal of the process was to create an inter-disciplinary undergraduate degree program that would effectively utilize our already existing faculty and curricular resources in Business Management and Computer Science. The project was lead by two faculty members (one from each of the academic units stated above). The process culminated in the acceptance of a new program of study for Information Systems by our faculty and administration. The project was not without obstacles, however.

The first order of business was the determination to utilize the IS'97 and IS 2002 curricular standards as a guide (ACM 2002). Our intent was not to seek accreditation, but rather to adhere to an accepted standard and optimize our current resources. Our committee determined that in order to overcome the political hurdles on campus, we needed to demonstrate that we would not require any substantial funding. Thus, we would create a curriculum that did

not make demands for additional faculty positions. We did create a few new courses for this program. The Computer Science department created two new courses: eCommerce and Programming Languages for Information Systems. The Business department created two new courses as well: Knowledge Management and eBusiness Systems. The existing courses in CS included in this major were: Introduction to Computing, Java Programming 1 & 2, Database, and Software Engineering. The Business courses/areas were: Economics, Accounting, Business Statistics, Finance, and Management. Additional electives for the new IS major could come from Business (e.g., International Business) or Computer Science (e.g., Networking).

The reader will note an imperfect correspondence between our courses and the IS 2002 courses. For example, we have "Software Engineering" instead of "Project Management and Practice." The rationale is that our Software Engineering course places a heavy emphasis on many aspects of project management. Furthermore, this illustrates our overarching goal of minimizing cost and working within our existing framework of curriculum and faculty. The model with a significant overlap of courses in both the CS and IS programs is not without precedence (Harrington 1995).

At the time we started the project, our college enrollment was 1,900 traditional, full-time, residential students. The Business majors numbered just over 500 whereas the Computer Science students numbered 40. Our hope and expectation was that we would have twice as many IS majors as CS majors in five to ten years. We have not experienced numbers even close to this expectation as of this writing (May 2007 IS enrollment was 13 students). Unbeknownst to us, we were entering at perhaps the worst possible time.

3. IMPACT OF NSF FUNDING ON ENROLLMENT

The National Science Foundation created S-STEM (Scholarships for Science, Technology, Engineering and Mathematics) to promote interest among citizens and permanent residents in the technology-related disciplines. S-STEM was formerly known as CSEMS (Computer Science, Engineering, and Mathematics Scholarships – we'll use the S-STEM designation to refer to either program). The name was changed to indicate a broader scope and be more inclusive of fields such as Information Systems.

One of the attractive features of the S-STEM program is that it is accessible to colleges and universities in just about any niche. We will review some typical examples. A large, urban university received two grants covering multiple disciplines (Yue 2007). A small college with no prior grant-writing experience and little grant-writing support has received significant funding (Gerhardt 2004). A community college system reached a significant target audience of women and under-represented groups with an award (Sorkin 2005). A liberal arts college used a grant to support a CIS program with a modest impact on enrollment (Martincic 2003).

The same year that we designed our Information Systems program, we applied for and received a $200,000 S-STEM grant (NSF 0123198). Since our Information Systems program was not officially a part of our college program of study at the time of our S-STEM application, our grant only included our CS program. We will now look more closely at some of the outcomes and lessons learned from our S-STEM grant.

During our first year we adopted a strategy of trying to attract students interested in studying CS to our college. We experienced immediate failure with this approach as we learned that we needed to recruit students who were undecided about a major who had already determined to attend our college. In hindsight, the reasons for the shift in strategy are quite reasonable. Our institution serves a regional audience of students who are interested in attending a tradition, liberal arts college that is entirely residential. In short, our incoming students tend to pick the institution first and their major second. We found that students who are clear on the choice of a CS major tend to be looking for traditional "engineering" type schools (e.g., RIT, RPI, Georgia Tech, etc.). Our relatively high cost of attendance coupled with the original limit of $3,125 per year on STEM scholarships did not prove to

be an enticement for most CS students to consider our institution.

By quickly adapting to the situation, we were able to utilize the STEM funding to attract students with strong academic promise and demonstrated need (according to the FAFSA requirements). Since our institution is one of three Phi Beta Kappa schools in our state, we were able to focus our attention on a smaller audience of talented incoming freshmen each year. The table below shows our recruiting statistics for the first three years of our grant.

Academic Period	Invites to Apply	Actual Appl's	Offers	Accepts
2001-2002	**20**	**13**	**8**	**6**
2002-2003	**35**	**19**	**15**	**9**
2003-2004	**39**	**17**	**11**	**6**

Table 1. Recruiting Statistics.

As Table 1 shows, we sent out an average of 31 invitations, which produced about 16 applications (for a 50% yield for applications). Those 16 applications resulted in an average of 11 scholarship offers (69%). And those 11 offers resulted in about 7 enrolled participants (64%). Therefore, if we consider the entire pipeline, we started with a total of 94 contacts (the "invites" over a three year period) and ended with 21 enrolled students for a final rate or yield of 22%. An important detail to mention is that we first submitted the names of the "invites" to our financial aid office to determine financial eligibility, since we did not want to frustrate students by later informing them that they did not meet the eligibility requirements.

As stated above, CRA has reported undergraduate CS enrollment declines of about 50% since the fall of 2000 (Vegso 2007). During the same period, our institution experienced a decline in overall computer science enrollment of about 31%, which is well below the national average. Although it would be difficult to prove this point, we believe that a significant factor in this statistic has been the availability of NSF scholarship funds in attracting students to our program.

In addition to the goal of increasing our course enrollments, our 2001 grant proposal indicated a desire to attract more females to our program. Here again we faced a national trend moving in the other direction: from 2000 to 2004 the percent of undergraduate CS degrees awarded to women declined from 19% to 17% (Carlson 2006). Our female enrollment averaged 21% in the five year period before our STEM award. In the five year period corresponding to our STEM program, our female enrollment has been 22%, but more significantly our female STEM scholars represent 26% of the total from 2002-2006 and 38% of the 2007 total. We feel that the STEM program is clearly a significant cause of above average female enrollments.

To give the reader some sense of the effectiveness of this CSEMS program, we compared our overall retention rate of CS majors within the CSEMS program with another similar program administered during the same time period, 2002 through 2007 (Russo, 2007). The definition of retention here includes students not only remaining with the institution but with the major as well. Ideally, we would like to utilize data from many different programs. However, relatively few of the reports are publicly available for such purposes. The overall retention of our CSEMS students was 60%. In the comparison group, their retention was 54% among CS majors. The comparison pool also included IT majors along with Math and a few others. Our program proposal did not include majors outside of CS. Nonetheless, if we include the IT majors in the group with CS, their overall retention rises to 68%. The bottom line of this comparison reveals that we are in the range of the experience of other institutions.

4. OBSERVATIONS AND CONCLUSIONS

The fact that both the NSF project and the new IS program began during the same time period introduces two variables in our college's educational system that are not entirely possible to separate. Although our

CS enrollments have experienced much more modest enrollment declines than what is reported elsewhere in the literature, if we take into account our IS enrollments, our numbers have remained constant over the past five years. The result has been that many of our course enrollments have been constant due to the overlap between our CS and IS curricula.

When we presented our IS program proposal to our college curriculum committee, we were asked to project future enrollments for the major. Based on enrollments at colleges of similar size that had both CS and IS programs, we expected that our IS enrollment would eventually reach twice the size of our CS program. Our CS program at that time had 40 students. Therefore, we expected that our IS program would reach an enrollment of about 80 students after about five to ten years (i.e., 2007-2012). We currently have 13 Information Systems majors in our college and 27 Computer Science majors (May 1, 2007). Clearly, the numbers of Information Systems majors have not materialized anywhere close to our expectations. However, as we stated earlier, based on the enrollment trends nationwide, we unwittingly chose an unfortunate time to start this new endeavor.

Beginning with 2006-2007 academic year, we have begun to explore the anemic growth in our Information Systems program (we began with three students in 2002 and increased to only 13 four years later). After investigating the profiles of students in the program, we quickly ascertained that most of the IS students are former CS majors who switched to IS. We believe the missing numbers are potentially from our Business program (currently over 500 students). Since the faculty member who co-authored the IS major has been on an extended sabbatical for the past three years, we have not had much exposure among the Business majors. Therefore we have started a program to increase the exposure of our program among this target audience. Working with the Chair of the Business & Accounting Department, we have begun to provide guest lecturers for the Information Systems material in the freshman "Foundations of Business Administration" course, which has annual enrollments exceeding 200 students (divided over the fall and spring semesters). At the conclusion of these lectures (which are designed to put a very positive and media-intensive spin on the Information Systems program), we provide students with information on requirements necessary to complete a major or minor in Information Systems. The minor was added in the 2006-2007 catalogue as part of another joint curriculum initiative between CS and Business.

In conclusion, we have experienced that the "if you build it they will come" philosophy of starting an undergraduate Information Systems program did not work. It is still too early to discover the results of our efforts to "advocate" for the IS program among the general Business major population. Furthermore, we are certain that the NSF funding softened the impact of the declining enrollments among our CS population. We are tempted to think that our timing to begin both the new IS major and the NSF STEM program was ill-fated. But if we consider the "glass is half full" line of thinking, perhaps the timing for both of these initiatives was perfectly suited to maintain our enrollments and, more importantly, position us for what we believe will be an inevitable increase in enrollments as the market factors begin to drown out the mantra of the media's sometimes exaggerated or poorly contextualized reports about offshoring, downsizing and employment quagmires for technology workers in the 21st century.

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