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Curriculum Decisions: Assessing and Updating IS Curriculum

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ABSTRACT

The increased level of accountability in higher education has prompted many computer-related programs to seek accreditation. As accrediting agencies continue to define and refine exactly what these degrees should entail, institutions struggle with the decisions of aligning their curriculum with a dynamic set of standards set by an outside agency, focusing on the needs identified by their own assessment data, or attempting to marry the two. This paper details how one institution completed comprehensive reviews of their curriculum under two different projects: Expanding Pathways for Educational Development and Information Technology Experiences, an NSF-funded research project investigation and examination of curriculum and regional needs and an ABET evaluation and site visit. The focus of this report is to inform others of local efforts that may be replicated on their campuses, share findings that may be of use to others in similarly situated circumstances, and add to the assessment and accreditation dialog.

Keywords

IS Curriculum, Assessment, Accountability, ABET, Learning Outcomes

INTRODUCTION

The curriculum in information systems and other computing disciplines continues to evolve and to grow in importance and need. While course enrollments and job availability fluctuate from location to location and month to month, the need for qualified professions on a national level remains high. According to Henry Steininger, managing partner for Grant Thornton and Vice Chairman of ITAA, "Companies are struggling to find enough people in the U.S. with the right mix of talent to meet the market's needs. America's education system and immigration policies just have not kept pace with the changing economy." He also points out that our "best and brightest" are "choosing other fields or working for our competitors overseas" (ITAA, 2006).

The Secretary of Education's Commission on the Future of Higher Education indicates in A Test of Leadership: Charting the Future of U. S. Higher Education: "In this consumer-driven environment, students increasingly care little about the distinctions that sometimes preoccupy the academic establishment, from whether a college has for-profit or nonprofit status to whether its classes are offered online or in brick-and-mortar buildings. Instead, they care – as we do – about results" (U. S. Department of Education, 2006). While many in higher education may take opposition to this report (often referred to as the Spellings Report), the reality is that our students are more informed and they are asking questions.

One of the goals set forth by this Commission for higher education is to provide "high-quality instruction" (U. S. Department of Education, 2006). The U. S. Secretary of Education created the Commission in 2005 and charged the Commission to examine four key areas: access, affordability, quality, and accountability. The Commission found that problem areas were compounded by the lack of information about quality and cost and a significant lack of accountability mechanisms. Although the Commission indicated that there has been increased attention to student learning by academic institutions and accreditation agencies, they feel more should be done in this area.

Computing education must revitalize their curriculum in order to meet the challenges of the 21st century. In November 2007, six computing accreditors, including ABET, Inc, the Australian Computer Society, the British Computer Society, the Canadian Information Processing Society, the Japan Accreditation Board for Engineering Education, and the Accreditation Board for Engineering Education of Korea, signed an intent to establish a shared vision of computing education called the Seoul Accord (ABET, January, 2008). This accord, and the newly created working groups, is expected to establish guidelines for computing curriculum.

CURRICULUM VS. SKILLS NEEDED

In 2006, Fairmont State University began to review computer-related curriculum, industry needs, and how a student could have a seamless transition from high school to a career in information technology through an Associate of Applied Science in Information Systems or a Bachelor of Science in Information Systems. Data was collected and national curriculum efforts were reviewed to ensure that the items taught in the courses matched the needs of the occupations, the local area, and the national computing curriculum efforts. This project was undertaken with the support of an NSF grant, Expanding Pathways for Educational Development and Information Technology Experiences (ExPEDITE) Project. In addition to published curriculum literature, the two main sources of data used for curriculum analysis were position skill sets for technology-oriented jobs obtained from Department of Labor and a survey of local industry.

The motivating rationale for the ExPEDITE Project was the need for trained IT professionals in West Virginia. The recession of the 1980s led to a rapid decline in mining and manufacturing jobs. Currently, high technology is a major factor in the process of economic re-development in West Virginia. In the central West Virginia region, a portion of the I-79 interstate has been deemed "the High-tech Corridor," because there are many high-tech companies that have located there. As is the national trend, in direct contrast to the growing need for high tech workers in West Virginia, there is an overall shortage of workers to meet the needs of businesses that offer careers in IT fields. The ExPEDITE Project was developed to ensure that academic programs in West Virginia are preparing our students for these high tech careers and to increase the number of West Virginia students entering the high-tech workforce.

Analysis

In order to determine if courses were teaching appropriate material and had accurate student learning outcomes, curriculum was analyzed using the Computing Curriculum 2005 standards, published IS curriculum efforts, local industry needs, and position skill needs. To determine skills needed in the area, a survey was sent to local technology businesses to determine the area needs in terms of positions and skills. Companies were asked to anticipate types of positions they expected to hire and what skills they needed these employees to possess.

Most IT companies in North Central West Virginia (WV) are branch offices of larger companies with staffs ranging from 9 – 80,000 employees. The offices in WV vary in size from one to 200 IT workers; 95% of these offices have 100 or less IT employees and 84% have fewer than 50 IT employees. The type of IT work being done in North Central WV includes IT Consulting, Custom Software Development, Installation Maintenance and Repair, System Design & Integration, Network/Systems Engineering Support, Biometrics, Computer Programming, Information Retrieval, Data Processing, Computer System Design, Higher Education/Training & Development, IV&V software systems, Research & Development using IT, Community Rehabilitation Programs, Aircraft Maintenance, Unmanned Vehicles, Software Assurance, Financial Services, and Health Care.

78 % of respondents of the surveys indicated Software Engineering as the IT occupation in the highest demand. Other occupations currently in demand are Technical Program Managers (67%), Programmers (44%), Quality Assurance & Testing (44%), Network/Data Security (44%), System Engineers (44%), Database Administrators (33%), Information Systems Operators/Analysts (33%), and Systems Analysts (33%).

The results from the skills feedback indicated that while respondents reported the need for Oracle database and Unix skills, the primary needs identified in the survey were non-technical skills, or soft skills (see Figure 1). The two skills found most valuable by 89% of respondents were Written Communication and Teamwork. Over half the respondents also identified Creativity and Verbal Communication as valuable skills. Finally, Computer Programming made the list followed closely by other technical skills

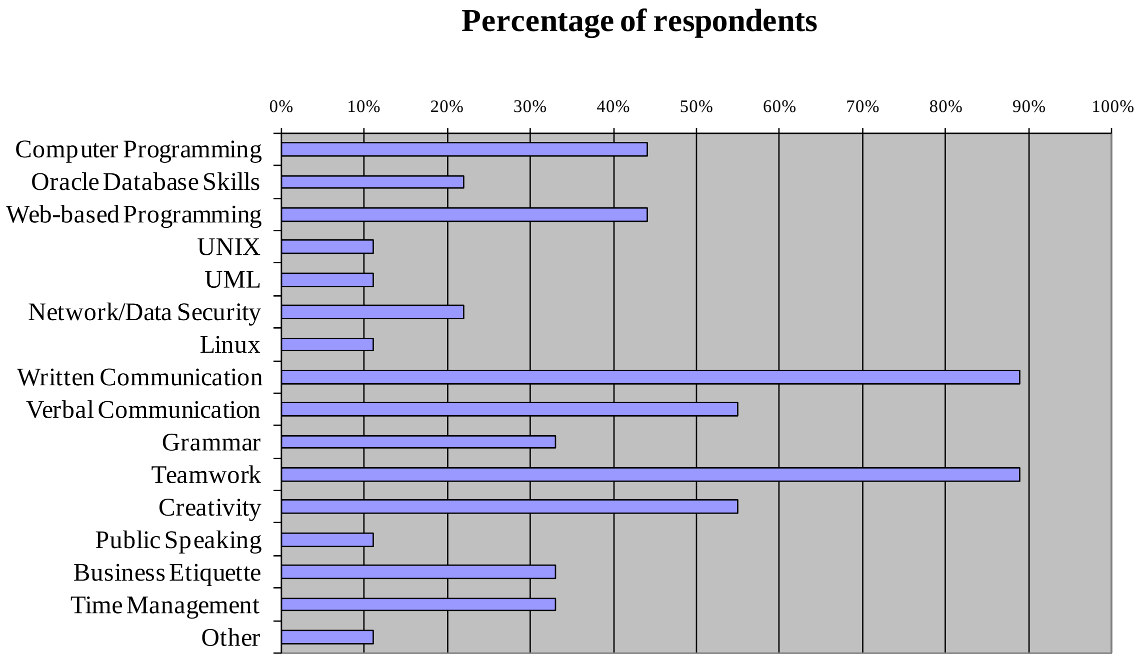

Figure 1. Most Valuable Skills

Next, skill sets were obtained for technology-related positions from the U. S. Department of Labor (DOL). To assist this effort, IT-related jobs were analyzed to determine the skill sets required to perform the job and what components were essential to being a productive member of that occupation. The job categories selected for this study included Management, Computer and Math, Maintenance and Repair, Administrative Support, Architecture and Engineering, and a broad category for general living skills. These categories were selected directly from the DOL published occupations.

There are many areas where University courses are fed by courses at the lower levels. Previous analysis identified the flow structure of these courses and the impact of changes throughout the curriculum. While these courses are an important component in educating students, the changes that are made in University curriculum impact not only the students that are enrolled, but also the graduates that are then employed by companies in the workforce, and ultimately the entire IT workforce. To aid decision-making at this level, multiple methods were used to determine where gaps exist. This included perquisite mapping, document analysis, personal communications, team working sessions, and literature review.

Once all the data was collected, courses offered at the local high school, associate, and bachelor levels were mapped to the required skills identified both in the local industry survey and in the position listing. Additionally, data was analyzed from research, published industry surveys and career guides for IT. One such national survey (ITAA) found that the best background in IT jobs appears to be experience in a related field (46%) and a 4-year college degree in a related field (41%). In addition, the survey found that soft skills were critical to obtaining and retaining IT-related jobs (ITAA, 2004). Direction for curriculum efforts and decisions were made based on local findings, potential impact, and the results of similar efforts reported in the literature.

Findings

After reviewing the literature, examining the curriculum, and analyzing the collected data, it was determined that, at the University (BS) level, the following efforts had the potential to strengthen the pathway to a career in technology:

1. Creating a "Computing Across the Professions" learning module to explain to students the potential areas of computing and how graduates could obtain a position in one of the technology areas. This course resulted from the large

number of technology-related positions in different content areas (accounting, healthcare, etc.). In addition, it is thought that this knowledge will limit the number of transfers between the computer disciplines on campus as understanding distinct computing differences has been problematic for many undergraduates. The course module is planned for fall 2008 and is under consideration for inclusion in the liberal studies curriculum. In addition, this module will be made available to high schools and other institutions for potential inclusion in their curriculum.

2. Incorporating more soft skills into existing courses without increasing the course load for students or faculty and reinforcing soft skills at all levels. This is a deliberate effort to identify appropriate locations in the curriculum to teach and then reinforce soft skills, especially communication (oral and written) and teamwork. This includes adding specific soft skills to the outcomes and objectives at all levels. Although it is too early to form concrete conclusions about the increased focus on soft skills, student performance in classes has improved, students have indicated their level of problem-solving has increased, and students seem to be more relaxed in subsequent courses and are not as anxious when given assignments that involve presentations and writings (it is now understood to be an expected course requirement). The use of these skills throughout the curriculum eliminates some of the skill retention issues and also allows students to get used to performing the skills before graduation (perhaps overcoming some apprehension especially in presentations). This addition of soft skills is supported by the DOL findings and research studies investigating the demands of the work force (Bailey & Mitchell, 2006; Plice & Reinig, 2007).

3. Creating better collaboration and communication between IS and CS programs. This includes potential cross-discipline projects and collaboration of classes and students. In addition, joint CS/IS/IT/Tech Freshman Seminars and Learning Communities are being investigated. This recommendation is due in part to the common skill sets required of the disciplines. One survey of potential shared courses was completed by Bills and Canosa of Rochester Institute of Technology (RIT) and investigated the use of a shared introductory-level programming course in all computing disciplines. They list likely advantages as economy of scale, reduction of redundancy, and the ability to leverage the talents of faculty across distinctly different disciplines (Bills, 2007). Although Fairmont State does share a common course in programming at the introductory level, the outcomes are driven by the needs of the Computer Science Department (the home department of the course). To make better use of the course, the CS and IS departments need to collaborate to determine shared needs and time on topics, similar to RIT.

4. Increasing the number of non-course related learning experiences for students. This includes technical software-related workshops available to students who are enrolled in classes (SQL Server, Windows administration, Oracle, etc.), certification-preparation workshops, and soft-skill workshops (specifically in the areas of problem-solving, team-building, project management, and written and oral communication). In addition, the IS student organization has created a design team whose purpose is to individually specialize and then use peer teaching to train other students in new skill areas, especially in web and graphic design.

5. Increasing the number of potential electives available for students to take (this may include creation of new courses and/or including a larger list of current courses). This effort is in the very beginning stages and no details are available at this time.

6. Increasing the number of students who are members of professional student organizations (e.g. ACM, IEEE, PMI, etc.). Part of the justification for this is to provide students with opportunities to network and practice their soft skills. In addition, we are working to increase the number of students who participate in internships (and multiple placements) and internship opportunities available by forming more formal partnerships with industry. The ExPEDITE project provided an opportunity for additional intern and fellowship opportunities and, although the qualitative evaluation feedback was very positive, we are currently assessing the effectiveness of this project using a formal survey.

CURRICULUM VS. STANDARDS

In 2007, Fairmont State University Information Systems Program completed a self-study for ABET and had a visiting team on campus for potential ABET accreditation. During the spring and summer of 2007, curriculum was analyzed to determine the extent to which existing courses met ABET standards. It is worth mentioning at this point, without going into detail, that there were known issues of concern with respect to the ABET standards prior to beginning this process; however, to coordinate site visits with other ABET commissions, a request was put forth to ABET to evaluate the IS program. Among these issues were curriculum deficiencies in the quantitative area and some financial concerns. The curriculum areas were in process during the time of the site visit, based on results from previous analysis, and the financial limitations are consistent with the national state of public higher education.

Analysis

As shown in Table 1, there are 16 ABET standards relating to Information Systems Curriculum. A review of the standards shows that students must have at least 30 semester hours of study in information systems topics, at least 15 semester hours of study in an information systems environment, such as business, at least 9 semester hours of study in quantitative analysis, and at least 30 semester hours of study in general education. The information systems area is further broken into core content and advanced content and, there are specified content that must be covered (see Table 1).

Table 1. ABET Curriculum Standards 2006-2007 (ABET, 2007)

Standard IV-1.	The curriculum must include at least 30 semester hours of study in information systems topics.
Standard IV-2.	The curriculum must contain at least 15 semester hours of study in an information systems environment, such as business
Standard IV-3.	The curriculum must include at least 9 semester hours of study in quantitative analysis as specified below under quantitative analysis.
Standard IV-4.	The curriculum must include at least 30 semester hours of study in general education to broaden the background of the student.
Standard IV-5.	All students must take a broad-based core of fundamental information systems material consisting of at least 12 semester hours.
Standard IV-6.	The core materials must provide basic coverage of the hardware and software, a modern programming language, data management, networking and telecommunications, analysis and design, and role of IS in organizations.
Standard IV-7.	Theoretical foundations, analysis, and design must be stressed throughout the program.
Standard IV-8.	Students must be exposed to a variety of information and computing systems and must become proficient in at least one modern programming language.
Standard IV-9.	All students must take at least 12 semester hours of advanced course work in information systems that provides breadth and builds on the IS core to provide depth.
Standard IV-10.	The 15 semester hours must be a cohesive body of knowledge to prepare the student to function effectively as an IS professional in the IS environment.
Standard IV-11.	The curriculum must include at least 9 semester hours of quantitative analysis beyond pre-calculus.
Standard IV-12.	Statistics must be included.
Standard IV-13.	Calculus or discrete mathematics must be included.
Standard IV-14.	The oral and written communications skills of the student must be developed and applied in the program.
Standard IV-15.	There must be sufficient coverage of global, social and ethical implications of computing to give students an understanding of a broad range of issues in this area.
Standard IV-16.	Collaborative skills must be developed and applied in the program.

In addition to the curriculum, ABET has five statements about assessment and objectives:

Standard I-1. The program must have documented educational objectives.

Standard I-2. The program's objectives must include expected outcomes for graduating students.

Standard I-3. Mechanisms must be in place to periodically review the program and the courses.

Standard I-4. The results of the program's assessment must be used to help identify and implement program improvement.

Standard I-5. The results of the program's review and the actions taken must be documented.

FINDINGS

The Fairmont State University IS degree was first offered in the academic year 1999-2000. Since that time, many data have been analyzed and decisions have been made with respect to the creation of learning outcomes and course content. Assessment of student learning outcomes in the IS Department at FSU is comprehensive, grounded in the theory and best practices of assessment, and solidly aligned with IS standards. The use of student learning outcomes is common in higher education and Figure 2 shows a sample of a partial course outcomes and department outcomes mapping for a course in the IS department at Fairmont State University.

Learning Outcomes	Course 4430.1	4430.2	4430.3	4430.
	Discuss the roles played by information technology in today's business, and define various technology architectures on which information systems are built.	Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage	Identify the basic steps in systems development and examine the processes of planning, designing and implementing MIS for an organization.	Understand the MIS func as MIS strategic planning support, customer-facing decision support systems
Department: A solid foundation in the theory and application of information systems design, development, and management.	Case Page 20, Case Page 196, Case Page 207, Case Page 300, IS Real World Discussion Posting, Activity 1, Activity 2, Midterm Exam, Final Exam	Case Page 20, Case Page 442, Activity 2, Midterm Exam, Final Exam	Case Page 101, Case Page 107, Case Page 196, Case Page 207, Case Page 378, Case Page 518, Case Page 540, Midterm Exam, Final Exam	Case Page 48, Case Page Case Page 249, Case Pa 488, Activity 2, Midterm
A background in the mathematics, computational tools, physical sciences, and business methods useful for information system professionals.	-	-	-	-
Opportunities for creative, original and critical thinking in solving information systems problems.	Activity 3, Activity 4, Final Project, Final Presentation	Midterm Exam, Final Exam, Final Project, Final Presentation	Activity 4, Activity 7, Final Project, Final Presentation	Activity 4, Activity 6, F Presenta
Opportunities for development of strong verbal and written communication skills.	Case Hosting, Final Project, Final Presentation	Case Hosting, Final Project, Final Presentation	Case Hosting, Final Project, Final Presentation	Case Hosting, Final Presenta
Development of a sense of professional ethics and of responsibility to the community.	-	-	-	Case Pa
An appreciation of interpersonal and management skills, teamwork and an ability to work collaboratively.	IS Real World Discussion Posting, Activities 1-7, Case Hosting, Midterm Exam, Final Exam, Final Paper, Final Presentation	Case Hosting, Final Project, Final Presentation	Case Hosting, Final Project, Final Presentation	Case Hosting, Final Presenta
Appreciation and understanding of the social, economic, political, and legal context in which professional activities are undertaken.	Case Page 300, IS Real World Discussion Posting	Case Page 408, Case Page 446, Case Page 492, Final Project, Final Presentation	Activity 7	

Figure 2. Partial Sample Course Outcomes vs. Department Outcomes Mapping

As indicated above, there are five standards with respect to assessment and objectives. On the surface, these seem like standard assessment practices, however, ABET's learning outcome requirements are more complex. ABET requires program educational objectives and learning outcomes. Program educational objectives are broad statements that describe the professional accomplishments that the program is preparing graduates to achieve and learning outcomes are statements that describe student expectations upon program completion. The current IS objectives are as follows:

Graduates of the Information Systems Program at Fairmont State University, approximately five years from graduation will:

1. Contribute to the economic development and society through the development and management of information systems by meeting the skills in demand and the employment needs of Fairmont and the surrounding community.

2. Advance their career by applying academic competencies and methodologies in addressing and solving problems as an information systems professional.

3. Communicate effectively to audiences of varying demographics and agendas through the practice and application of learned technical and non-technical methodologies.

4. Lead team projects and function effectively as a member of a team.

These objectives are assessed and merit further consideration and refinement as the FSU IS program grows and matures. To better understand the professional accomplishments that the IS program should be preparing graduates to achieve, faculty and administrators have decided to create a common understanding of the computing curriculum across the different disciplines at Fairmont State, similar to the recommendations set forth in Computing Curricula 2005. Initial steps in this process are identifying the common core skill sets among the computing disciplines and then clarifying the differentiators among the IS, IT, and CS program pathways.

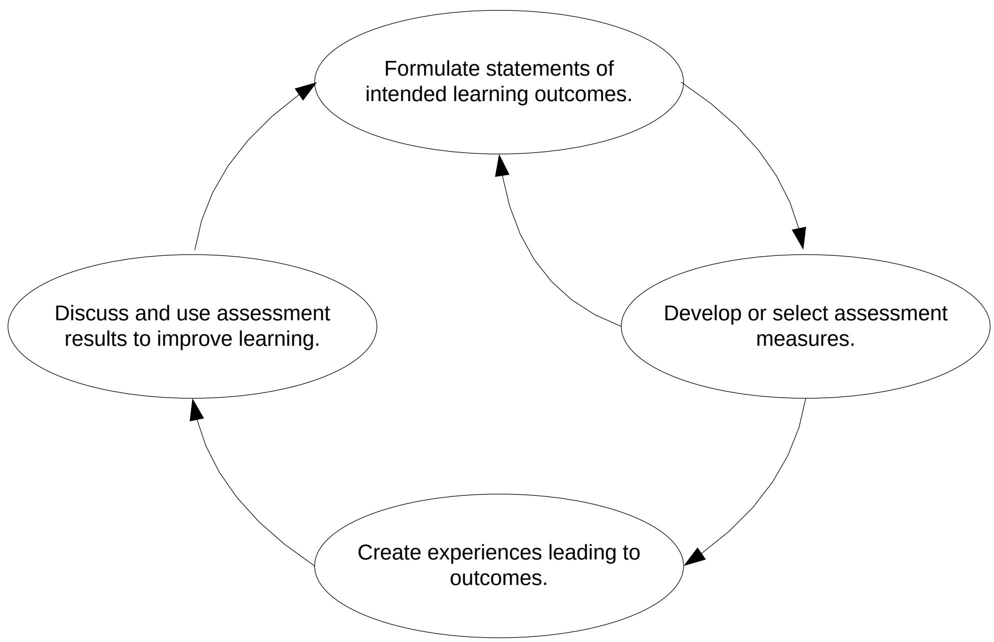

Figure 3. Huba and Freed Assessment Model

Assessment, very like the Total Quality Management (TQM) and Continuous Improvement, requires a dedicated on-going effort and a feedback loop to complete the cycle. This process, as explained by Huba and Freed (2000), is shown in Figure 3. Too often, assessment is conducted as the time for accreditation approaches. This compliance approach uses an external motivator. A better approach is when the faculty and professional staff seek to answer questions in an on-going process (Maki, 2002). In addition, integrating assessment with other ongoing performance improvement efforts enhances the long-term viability and usefulness of the assessment program (Bennion & Harris, 2005).

SUMMARY AND CONCLUSIONS

The two curriculum reviews detailed above both provided valuable information into the IS program and course offerings at Fairmont State University. Both were strongly influenced by student learning and supported the idea of common learning outcomes for courses in the department. In addition, course matrices were used in both analysis to provide a comprehensive view of how well the curriculum fit the skills and standards of the various areas in each evaluation. An understanding of the curriculum and the process was also required in both instances.

The focus of the two evaluations was decidedly different. In the initial evaluation, the pathway to a career was the motivating factor in determining evaluative criteria. In the ABET study, the standards provided the points for evaluation. While they were both concerned with quality of program, the ABET guidelines set standards for quality based on a national norm or understanding of information systems while the local study allowed more flexibility in determining factors.

The Association of American Colleges and Universities (AAC&U) board of directors has stated that "it is not enough for an institution to assess its students in ways that are grounded in the curriculum; colleges and universities must provide useful knowledge to the public about goals, standards, accountability practices, and the quality of student learning" (AAC&U, 2004, p. 9). The completion of these types of curriculum analysis provides a basis for decision making that is grounded in need and research. By showing constituents the justification of curriculum changes and how the curriculum is preparing students to enter the workforce, Fairmont State is meeting this additional criteria.

Curriculum decisions are not easy. There are multiple methods for analyzing the needs of the IS department and multiple methods should be considered to capture the entire picture of the program and internal and external constituent needs. The ability to triangulate findings provides reliability and a sound basis for making improvements to curriculum. Programs can focus curriculum in areas that make sense for stakeholders but still meet the intent of accreditation standards set by ABET or another accreditation agency. In fact, Prichard, Potter, and Saccucci (2004) found that "to be effective, an outcomes assessment program must match stakeholders and their goals" and Gloria Rogers, in ABET's Assessment 101 calls the role of stakeholders in determining and evaluating objectives "essential to programs understanding of their needs" (ABET, March, 2008). The idea is to meet the intent of the accrediting agency standard while setting program-level outcomes and objectives for graduates. In addition, assessment results should be used in developing curriculum, institutional planning, program review, and other decision-making on campus (Huba & Freed, 2000). Accreditation standards provide assurance of core content. In one study of IS programs in the US, a great deal of consistency was found in the core courses of programs housed in AACSB-accredited Business Schools (Kung, Yang, & Zhang, 2006). This is to be expected as AACSB has common core requirements for curriculum and assessment of student learning. AACSB (2005) believes that by measuring student learning, the school and faculty members can improve the program and courses.

Moving forward, the Spellings Report also recommends postsecondary education institutions "measure and report meaningful students learning outcomes" (U. S. Department of Education, 2006). The Commission found that "at a time when we need to be increasing the quality of learning outcomes and the economic value of a college education, there are disturbing signs that suggest we are moving in the opposite direction" (U. S. Department of Education, 2006). The Commission also recommended that accreditation agencies make performance outcomes the core of their assessment (U. S. Department of Education, 2006). Hopefully, the new Seoul Accord will keep this in mind and will use performance indicators in their recommendations for standardized computing curriculum.

Based on the success of the FSU industry survey and the curriculum analysis, other institutions should consider conducting similar activities. Gaining a better understanding of the fit of specific courses and objectives of those courses allows focus in relevant areas, strength of purpose, and a shared mission among faculty, students, and other stakeholders. It is highly recommended that faculty entering into an evaluation year attend an ABET sponsored workshop before attempting to write the self-study. It is also recommended that the department prepare a schedule or milestone calendar to allow adequate time and attention to the events required to achieve accredited status.

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