

1. How has the outcomes assessment program been reflected in decision-making for determining personnel needs/issues?

The assessment process had identified that computer science students would benefit from:

- Assistance and mentoring in completing programming assignments, beyond that provided by the currently available faculty.
- Assistance in using the computer laboratory facilities managed by the department.
- Exposure to current ideas and techniques utilized by practicing software developers in addition to the expertise provided by current faculty.

Due to budget limitations within the State, and since the computer science program does not have a graduate component, the department has had to be resourceful in obtaining personnel resources to meet the needs identified by the assessment process. The department has undertaken meeting the identified needs by:

- using undergraduate students as laboratory assistants to provide support to students who are having difficulty with programming assignments. Upper-division CS majors who have exhibited programming competence as well as the appropriate interpersonal skills have been used in helping and mentoring roles as laboratory assistants.
- using undergraduate students to help support and maintain the computing infrastructure in the department. This role allows students to act as system administrators on both Windows and Unix based systems. In addition to providing a valuable administrative resource to the department, students now have an opportunity to gain hands-on experience in some aspects of system administration.
- having former graduates, who are member of the Computer Science Advisory Council, give guest lectures in selected courses. These former students donate their time and provide a low-cost "guest speakers bureau" that faculty may draw on. These former students speak on current topics in computing as well as provide current students with insights into professional programming environments. Student feedback on these speakers has been excellent.

2. How has the outcomes assessment program been reflected in allocating financial resources?

The assessment process indicated that students were seeking independent study experiences, research experiences as well as a capstone experience to enhance their educational experience in the computer science program. These undertakings provide students with out of classroom experiences that may be noted during job interviews or on resumes.

Based on this need, the faculty have been resourceful in obtaining resources to aid in conducting these types of activities. Specifically:

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

- A standing request has been made to Technology & Computing Services. The request asks that any and all retired PC's be first sent to the department for possible use in student projects. This had yielded a number of usable computers that have played an important role in allowing students to participate in independent study projects.
- A request was made to the Dean of LA&S to provide financial support for the purchase of previously used computers from Technology & Computing Services. The positive response to this request allowed two computers to be purchased. These computers will play a central role in several planned student research experiences.
- The department has requested and received funding through the ESU sponsored Program Proposals for FY2004 Enhancements. Funding has been received to conduct several student research experiences as well as take a number of students to an upcoming computing conference.
- A department faculty member submitted a proposal to the ESU Research and Grants Office for funding of a computer vision related student project. The funding received through this grant will allow this student based research move forward from a preliminary to a proof of concept phase.

The assessment results seem to indicate that our students are achieving high performance levels in the learning objectives. In order to maintain these results, we must continually monitor not only our curriculum, but also those resources that enable us to appropriately deliver that curriculum. Since the CS major is very technologically oriented, maintaining and upgrading our technological (both hardware and software) and human resources are fundamental to insuring that our students continue to develop high performance levels in the learning objectives. Hence we will continue to seek institutional support for more equipment and more faculty.

3. How has the outcomes assessment program been reflected in developing new programs?

The assessment process indicated that some students do not have the propensity or the native skill set to complete the course work required for the computer science degree. The department felt it was of paramount importance to provide such students with alternatives who wanted to be involved in a computing related field.

The department has developed and participated in developing several new programs in recent years to address these needs. The two certificate programs described below were developed within the department to meet the expanding needs of computing. Department faculty members were also instrumental in developing the recently approved Information Resource Studies (IRS) bachelor's degree.

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

- **Certificate program, Computer Science** – This 21-hour program is designed to prepare individuals trained in other fields to qualify for entry-level programming positions or to enhance their computing skills in an existing position.
- **Certificate program, Webmastery** – This 21-hour program is designed to prepare individuals trained in other fields to qualify for entry-level webmaster positions or to enhance their web programming skills.
- **Bachelor of Science, Information Resource Studies** - The Bachelor of Science in Information Resource Studies teaches students to understand the value of information to society, to organizations, and to individual professionals. Students are prepared to analyze the information needs of individuals and organizations and to design and manage information systems that meet specific needs.

4. How has the outcomes assessment program been reflected in making program changes?

The assessment process has allowed the department to identify learning objectives related to the computer science general competency list. From an educational standpoint, competencies can be regarded as the logical building blocks upon which assessments of professional development are based.

The faculty meets with students as well as the Computer Science Advisory Council to discuss curriculum enhancement issues as well as investigate ways to improve the delivery of our subject matter to the students. Fueled by students concerns surrounding exposure to topical issues in computing, several courses have been recently offered to address recent advances in computing:

- CS410, Computer Graphics
- CS523, Artificial Intelligence
- CS580, Introduction to Computer Networks

Another recent change has been encouraging students in the computer science program to participate in a capstone experience. The purpose of this requirement is that each student should undertake an extended activity that demands a significant individual effort. This criterion does not exclude team projects as long as each student contributes substantial work.

There are two general models for a capstone experience:

- Model 1: A substantial programming or design project of at least one semester in duration.
- Model 2: A research survey project in which the student explores and critically analyzes material beyond what is covered in a course and prepares a document to publicly disseminate what is learned to other members of the college.

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

The primary method for satisfying the capstone requirement is for students to take an elective course that is designated as an independent course. This is a course in which either there is a course project satisfying the capstone guidelines or in which the students may arrange a special project with permission of the instructor that will satisfy the capstone guidelines.

At the conclusion of the semester, the students demonstrate their projects in a public forum attended by departmental faculty members and students.

Most recently, the faculty has discussed scheduling of additional advanced courses to allow for more variety in the CS elective area. Typically, our desire for a stable, well-established collection of standard advanced courses that students could depend on, conflicts with our desire to offer a variety of advanced courses on recent developments in computing. The faculty discussed increasing the frequency of offering some elective courses to allow for more flexible schedule. More detailed discussion of this issue is planned for the future.

The assessment program has also identified problems concerning retention of students in early stages of the degree program. The department noted that students entering the program had wildly varying programming skill sets, and modifications to the course CS220, Introduction to Computer Science were necessary. The goal was to place all students on a relatively equal footing before taking CS260, Programming and Problem Solving.

Our qualitative assessment of student learning has yielded the following findings:

- Students who complete our program, learn the fundamentals of computing including problem solving skills, algorithm development, programming and developing effective solutions through group activities.
- Students acquire appropriate communication skills for the field.
- Students develop a broader perspective of the computing field.

Based on these outcome assessments, we have implemented a new approach for the CS220 course. The approach emphasizes creative thinking and problem solving without significant programming responsibilities. This approach utilizes:

- an embedded processor controller (OOPic), which provides exposure to fundamental programming skills as well object oriented (OO) concepts which are central in the CS260 course. The OOPic device uses a small language and a graphical user interface.
- exposure to graphics programming, which allows students to use a “C-language like” language to create a short video animation. The tool used here is PovRay, which is a relatively friendly ray-tracing tool. Use of PovRay has been found to desensitize students to the syntax and semantics presented in CS260.
- the Visual Basic language to introduce students to basic constructs in computing.

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

This “gentle introduction” allows students to enter the second course (CS260), after students having learned the rudiments of solving problems and basic programming language constructs.

In addition, the following course offerings will be added this year:

CSXXX - Windows Programming
CSXXX - Embedded systems programming

5. How has the outcomes assessment program been reflected in accomplishing departmental (program) goals?

The primary goal of our program is to prepare our graduates to understand the field of computing, both as an academic discipline and as a profession within the larger context of society. We try to achieve this goal in several ways. We provide a broad and coherent coverage of the discipline. We expose our students to the theory underlying the field. We expose our students to the ethical and societal issues associated with computers.

The assessment process has provided feedback, through student assessment instruments as well as through the Computer Science Advisory Council, to mediate the goals of the program and department. Specifically:

- Based on feedback from the Computer Science Advisory Council, the CS260, Programming and Problem Solving course, the data structures courses (CS340 and CS345) have assumed a more decidedly Object Oriented approach. This reflects current industry practice.
- Review of departmental retention data has prompted the changes implemented in the CS220 course, as described above.
- Based on feedback from the Computer Science Advisory Council, implementation of team programming, and specifically the use of extreme programming techniques, in the CS552, Software Engineering course.

6. How has the outcomes assessment program been reflected in decision-making relative to professional faculty development targeting student teaching and learning?

Input to the assessment process from both the Computer Science Advisory Council as well as discussions with employers representatives has signaled that computing remains an important area within business. However, the breadth and width of areas where computing is applied continues to expand.

Recognizing this trend, department faculty have developed a strong relationship with the National Computational Science Institute (NCSI). NCSI operates in partnership with the Education, Outreach and Training Partnership for Advanced Computational Infrastructure (EOT-PACI), The National Center for Supercomputing Applications, the University of Illinois at Urbana-Champaign, Clemson University, Appalachian State University, the National Computational Science Education Consortium (NCSEC), the

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

Burroughs Wellcome Fund, Sigma Xi, the North Carolina Supercomputing Center, and more than two dozen academic institutions, high performance computing centers and vendors.

NCSI holds workshops in Interdisciplinary Computational Science Education, Parallel and Cluster Computing as well as Computational Chemistry. Faculty have attended these workshops (Computational Science Education and Parallel and Cluster Computing workshops) and have returned with materials and insights that have influenced changes and expansion of the current program. Specifically, the following items have been spawned by the participation in NCSI activities:

- A student research project in parallel computing has been started. This project will utilize the computing capacity in the Brighton Mathematics Learning Center. The project will utilize the lab computers during non-student use hours to address solving computationally intensive problems.
- A program proposal is being generated, that will establish a computational science minor. This minor will be a joint undertaking of the department the Physics Department of the Departments of Physical Science. This program proposal is still in the preliminary stages.
- Several additions have been made to CS260, CS350 and CS552, based on the insights and materials gleaned from workshop participation.

7. What do your findings/conclusions from data analyses suggest about your students, programs and student learning?

Review of student retention data has suggested that improvements can and should be made to address student retention. The retention issues appear to center around the relatively low retention of students beyond the CS220 and CS260 courses. The department is keenly interested in the retention rate of its students in the second year in the program.

To address first year retention, the department has implemented and strengthened the following items:

- CS220 has been modified as noted under item 4 above to provide students with a background compatible with demanding requirements of CS260.
- Student assistants and mentors are made available in the computer laboratory (as noted under item 1 above) to help students in CS220 and CS260 to be more successful.
- A number of computer science students have difficulty with the mathematics requirements of the major. The expanded help sessions provided in the Brighton Mathematics Learning Center serve to address the student need for assistance in this area.

Discussions with the Computer Science Advisory Council have prompted a number of changes in emphasis in the program. Of note is the shift to a strictly object-oriented

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

computing approach and the emphasis on programming teams and the use of extreme programming techniques in the software engineering course.

8. Extent of faculty participation in the assessment plan, its implementation and decision making.

Implementation of the department's assessment plan depends on active involvement of faculty, students, and alumni, the availability of necessary resources, and support from the college and the university. In this process, there is a continuous assessment of evolving needs as well as development of feedback mechanisms and metrics to evaluate progress toward achieving plan objectives.

The department has developed mechanisms for providing feedback information at two levels:

1. Assessment of implementation of the current plan and progress toward stated goals; and
2. Continuous evaluation of driving forces, developments, and changes in the dynamically evolving computer science field. New needs and emerging opportunities will require continual review and refinement of the goals and priorities of this dynamic strategic plan.

The department's Computer Science Advisory Council, which includes former graduates in the computing field, has taken an active role in helping to create this assessment plan. Regular meetings of the faculty and the Computer Science Advisory Council are used to monitor progress. These meetings serve as an external review and as a forum for internal reflection.

Assessment updates and any significant developments in department are discussed by the faculty and integrated into the department's work on an ongoing basis.

Employers are constituents of our program, and thus their assessments of the program are critical. However, most employers do not respond to program surveys. To solve this problem, we conduct two types of employer-related fact-finding activities: recruiter discussions and internship reviews. Each year, recruiters who interview computer science students are visited by a faculty member and asked questions to determine whether our program outcomes are compatible with their needs. The process takes approximately 15 minutes and is performed during the recruiter's visit to campus. Career Services aids in this process and we have a high level of recruiter participation each year.

Many computer science students work as interns at some point in their academic careers. Companies employing interns are asked to provide feedback at the end of the internship to faculty. This feedback addresses how well the student performed his/her assigned tasks/duties and includes an assessment of the skills, knowledge and abilities of the intern. Although not as formal as the other surveys, these evaluations are extremely useful in assessing our program objectives and outcomes. They are generally considered

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

a very valuable form of student outcomes assessment, since they provide a direct measure of what has been learned in the program.

9. Extent of student participation in the assessment plan.

The department includes student input into the assessment process by student interviews conducted during the advising process as well as exit interviews conducted with graduating seniors. Students as well as faculty participate in the selection of future course offerings.

Each semester we conduct exit interviews with graduating seniors. This interview asks for their perspectives on the program and solicits a self-assessment of the skills and knowledge gained from their educational experiences. The interview includes both open-ended and forced-choice queries. The latter consist of a number of questions that are based on our specific program objectives. The other questions are more general in nature and relate to quality and accessibility of the faculty, physical facilities, the strengths and weaknesses of the program overall, and the student's plans for the immediate future.

As noted in previous sections, student input is vital to the dynamics of the departmental assessment process. Although students do not sit on the assessment committee panel, their input is central to the approaches considered.

As previously noted, the Computer Science Advisory Council plays a pivotal role in determining the direction of future courses, modification to existing courses and the general tone of the computer science program.

10. Are both UG and Grad programs equally implemented?

Only a B.S. in Computer Science is offered.

11. What major changes are you introducing this year to the assessment plan?

Our assessment process is decidedly informal. We need to establish and cement our formal assessment processes in order to improve our programs in a consistent and precise manner. This should be done in such a manner so that our assessment results are open for peer review. Assessment is a tool we can all use to provide better service and educational opportunity to our students. We need to ensure that all our graduates receive the quality educational opportunity we claim and advertise. The assessment process is iterative in nature and will start with input from various sources and end with output of quality graduates.

To this end, a computerized student portfolio system is being developed (as a software engineering student project) that will aid in retaining and tracking student work. This system will allow student work to be retained in a database. The database will be accessible to faculty for assessment reviews, as well as peer review. The system will be fully implemented during the Fall, 2004 semester.

Department of Mathematics, Computer Science and Economics
Computer Science Assessment

As mentioned previously, each semester we conduct exit interviews with graduating seniors. This process will be formalized by having students answer the interview questions in writing.

12. Available data.

- Student evaluations > 10 years
- Student grades > 10 years
- Student project and independent study reports – 3 years
- Retention data > 10 years
- Enrolled students > 10 years
- Pace and scope of new curriculum development - 7 years
- Peer teaching reviews – 7 years
- Diversity of student body and faculty > 10 years
- Faculty participation in teaching workshops > 10 years
- Student participation in research > 10 years
- Funding and fundraising success > 10 years
- Quality of educational facilities – 8 years
- Departmental budget information > 10 years