Assessing Computer Science Programs: What Have We Learned

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1. SUMMARY

How does a department evaluate the effectiveness of its major programs in computer science? In years past it might have been done rather informally by faculty members having a sense of what their students are learning and measuring that against curriculum guidelines developed by national organizations such as ACM and the IEEE Computer Society. Or, maybe faculty members might have made that judgment by the types of jobs their students were obtaining right after they graduate or the number of students who would go on to graduate school in computer science. Nowadays, however, because of both internal and external forces, computer science departments are introducing formal processes. These involve articulating objectives (or goals) and outcomes for their programs and using a variety of instruments to measure success in meeting those objectives and outcomes, all with the idea of using the results to improve the program.

Such a formal process for evaluating a department's programs by measuring student learning outcomes has become known as outcomes-based assessment. The driving force for this movement is the criteria of the regional accrediting agencies such as Middle States and North Central. At both SIGCSE 2005 and SIGCSE 2006 panels presented the highlights of this method of assessment [2,3]. Of particular interest was a description of ABET's Computing Accreditation Commission's (CAC) proposed new outcomes-based criteria for accrediting computing programs, including computer science [1]. However, neither the presentations nor the ensuing discussions were limited to only those programs that will be seeking accreditation or re-accreditation through CAC. All computer science programs are grappling with developing outcomes-based plans.

Because of the above, a logical next step in informing the computer science community about current assessment processes is to provide examples from departments that have already developed (and tested) outcomes-based assessment plans. This panel plans to do just that.

The participants in this panel come from a variety of institutions. All have experience in developing and implementing assessment plans that seek to articulate and measure learning outcomes for their students who are majoring in computer science. Each will present a brief overview of her/his department's assessment plan, what has been learned by going through this process (including successes and pitfalls), and what improvements, if any, have been made either to the program(s) or to the plan itself.

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Categories and Subject Descriptors

K.3.2 [**Computer and Information Science Education**]: Accreditation

General Terms: Standardization

Keywords

Assessment, accreditation, goals, instruments, objectives, outcomes

2. POSITION STATEMENTS

2.1 Bill Marion

(Note: as moderator I will introduce the other panelists and only elaborate on some of the things we have learned over the past two years from Valparaiso University's computer science assessment program during the audience participation section.)

2.2 John Impagliazzo

John is Professor of Computer Science at Hofstra University, New York, where he had served as its department chair and the director of its graduate programs. Some of John's current professional activities include serving as a consultant and expert for various countries regarding curricula, accreditation, and other activities, serving as a trainer for ABET program evaluators, and served as an ABET (formerly the Accreditation Board for Engineering and Technology) accreditation evaluator and team chair. He previously chaired the Accreditation Committee of ACM for twelve years. John believes that departments and universities should begin viewing themselves as businesses where goals, outcomes, and assessment are everyday occurrences. He will present some of the current thinking on assessment vis-à-vis computing accreditation and the current perceptions of computing programs.

2.3 Barry Soroka

Cal Poly Pomona is an ABET-accredited program, and we have an ongoing effort to assess our courses. We have a set of Program Objectives, and we have a set of witness courses which support the Program Objectives. For example, Program Outcome 5 is

"understanding of social and ethical issues in computing," and it is supported by courses CS 140 (Introduction to Computer Science), CS 420 (Artificial Intelligence), CS 431 (Operating Systems), CS 435 (Database Systems), and CS 463 (Undergraduate Seminar).

Each witness course has a set of Learning Outcomes that serve as guidelines for course instructors. Learning Outcomes are related to Program Outcomes. Each quarter, instructors collect student work and summarize how well (or poorly) each Learning Outcome has been met. Each year, our Assessment Coordinator hosts a meeting for each witness course where instructors review collected material and tune the Learning Outcomes. Our department's web page presents the various artifacts of the assessment process -- http://www.csupomona.edu/~cs/assessment

2.4 Deborah Whitfield

In 1995, the Computer Science Department at Slippery Rock University delved into assessment by creating course outcomes and program outcomes. In 1998, we began assessing those outcomes with student surveys; in 2000, we created a second assessment method (external appraisal) to receive input from external constituents; and in 2001, we established a third assessment method (course embedded) to tabulate faculty input. The department faculty have been involved with reviewing the data and modifying curriculum since the Fall of 2001; the external constituents began giving feedback in 2004; and the students reviewed the assessment materials in Fall of 2006 to provide their feedback.

The Computer Science student learning outcomes were revised in the Spring of 2006 along with the student surveys. The outcomes now consist of three major categories (1. Critical Thinking and Problem Solving, 2. Communication and Interpersonal Skills, and 3. Ethical and Professional Responsibilities) each with five outcomes. These outcomes can be viewed at: http://cs.sru.edu/ ~whit/assessment/CSOutcomes06.doc . We now have a formalized, completely functional assessment process in place that consists of measurable outcomes, three assessment methods for three different constituents, feedback from the constituents, a process for changing the curriculum, and the assessment of the changes.

Through the years, we have made numerous changes to the degree program including using the assessment data to increase the credit hours of advanced programming, modifying languages taught in the degree, moving topics from courses, adding ethics discussion to courses, and increasing credit hours for the major. All department faculty are now engaged in assessment discussion with their students, department colleagues, and college colleagues. Although we've been actively engaged in assessment for eleven years, we still have plans for many changes in the future.

Both the Computer Science and Information Systems degrees are ABET accredited and information about the programs and student assessment can be found at : http://cs.sru.edu/

2.5 Caroline St. Clair

North Central College is a comprehensive, liberal arts school that is accredited by the North Central Association of Colleges and Schools. Currently, each academic program within the college is required to participate in assessing student learning. At the start of every school year, each program submits an assessment plan for the coming year. The Curricular Assessment Committee reviews each plan and provides feedback with recommendations, if necessary. During that same time, programs submit an assessment report that discusses the previous year's assessment results with emphasis on the analysis of the results. Evidence of "closing the loop" must be provided in this report. Although assessment within programs has been ongoing for many years, the college-wide formal plan/review process has only been in place for two years.

For the past three years, the computer science department has been formally assessing student learning. During the first year, a comprehensive test was used, but students knew the results would not affect their grades and thus students did not take the test seriously. The following two years, specific questions were used on final exams within certain courses to assess particular learning outcomes. We felt this was a much better method of assessing our students and we have learned a great deal about our program over the past few years. Our analysis has led us to make a number of changes within our curriculum to improve student learning and hopefully retention.

As an associate professor of computer science at NCC and the chair of the Curricular Assessment Committee, I look forward to sharing our experiences with you during this workshop, both the good and the bad.

REFERENCES

[1] ABET Computing Accreditation Committee, *Criteria for Accrediting Computing Programs*, http://www.abet.org/LINKED%20Documents-UPDATE/Criteria%20and%20PP/C001%2006-07%20CAC%205-25-06-PROPOSED.pdf

[2] S. Cooper, L. Cassel, S. Cunnigham, and B. Moskal, "Outcomes-Based Computer Science Education, "*Proceedings of the Thirty-Sixth SIGCSE Technical Symposium on Computer Science Education*," pp. 260-261, 2005.

[3] S. Zweben, H. Reichgelt , and G. Yaverbaum, "Outcomes-Based Computing Accreditation, "*Proceedings of the Thirty-Seventh SIGCSE Technical Symposium on Computer Science Education*, pp.129-130, 2006.