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Assessment in the Department of Computer and Information Sciences at East Tennessee State University: An Overview*

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The process, motivation, mechanisms, as well as examples of some of the material used in assessment at the Computer and Information Sciences Department at East Tennessee State University, are presented. More details, and the supporting forms mentioned can be found at the website www.cs.etsu.edu/department/assessment.htm

Keywords: assessment; outcomes; objectives; educational outcomes; computer science

OVERVIEW

THE DEPARTMENT has 16 full time faculty members, 300 undergraduate and 50 master's students with about a two to one mix of traditional to non-traditional students. We support three concentrations, Computer Science, Information Sciences and Information Technology. Both Computer Science and Information Technology concentrations are ABET accredited. Our program is based on direct assessment of student work throughout their program of study. Each outcome is assessed by the instructors using a set of rubrics [1] to evaluate each student's performance on in-class projects or other assignments [2]. The departmental system is integrated with a program in our home college of Business and Technology that measures outcomes shared across all the member departments. Between these two programs student performance on each outcome is measured at least once every three years. The objectives are measured using surveys, exit interviews, and direct assessment by our advisory board.

There is one overarching principle in our program; while the motivation to formalize the program may have come from ABET, the motivation for assessing our work and improving our program comes from a desire to serve our students better. Without that motivation the program could not succeed.

OBJECTIVES AND OUTCOMES

The departmental outcomes and objectives were created by the faculty after a somewhat lengthy review of our curricula programs, and consultation with our advisory board which is comprised of regional employers and alumni. These were later revised and replaced by a much simpler set that is easier to measure and maintain. A hallmark of our department is the integration of our concentrations. All students share a large core of courses, and both the faculty and students identify themselves with the department rather than a specific program. This is reflected in our outcomes and objectives. The majority of outcomes and objectives are shared items across all concentrations with only a few that are concentration specific. The outcomes and objectives are listed in Appendix I where each item is cross-referenced with corresponding CAC student attributes [3]. This includes both the general A-I criteria along with the Computer Science, Information Science and Information Technology-specific attributes. In creating the outcomes, we used an iterative process finding commonalities to reduce their number and retained the specifics as sub items that would become the dimensions on which rubrics would be developed to measure our performance.

PROCESS

Every year, our students' performance on roughly one-third of our outcomes is measured. The faculty, in selected courses, uses a common rubric to assess performance of an in-class assignment. A schedule was agreed upon, and promulgated in the department listing exactly which rubric will be used to asses which outcomes in which course throughout the three-year plan. This is done to make sure all outcomes are assessed regularly, while keeping the burden on the faculty to a minimum. The data are summarized using auto-scoring rubrics [4] (see Appendix II). These are

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EXCEL workbooks that allow direct entry of raw data, and automatically generate item by item summaries, and graphs. The results of these measures are then evaluated by the assessment committee to look for trends and changes which are then acted upon by the curriculum committee. Note that in this process we are able to adopt several common college level rubrics. In this manner we generate data not only for our departmental review, but also for our college's AACSB assurance of learning program. This avoids having to evaluate the same skill set twice, and lessens the workload on the faculty and assessment committee.

To track and document changes in all required courses, each course coordinator annually archives the course's instructional materials (lectures, assignments, examinations, etc.) in a shared electronic repository. Every third year the coordinator reports, as part of a regular faculty meeting, on the current content, changes to content, and assessment data collected in that course. A sample report is shown in Appendix III. The three-year rotation ensures all courses are reviewed regularly, and that the review process does not become burdensome. To review the broader issues of our objectives we use regular surveys of our alumni and major employers. A recent innovation has been the creation of college wide surveys that address, with the addition of supplemental departmental questions, the core issues. This has taken the burden of survey implementation away from the departmental level. Synergy between departmental and college efforts have been key to building a sustainable program.

To get a regular external review of the objectives, our Software Engineering II course, which functions as the equivalent of a senior capstone, includes a presentation by our students of their project work to our external advisory board. The advisory board completes a rubric-based review of the students' performance on this capstone project. The rubric is based on the departmental objectives. Experience from early assessment cycles has taught us that the board functions best on the broad issues covered by objectives, while the finer-grained issues of outcome assessment are better addressed by educators. This review gives us baseline data of our students as they are about to graduate, and can be compared to data collected from alumni surveys.

In addition, the Educational Testing Services (ETS) major field test is administered to our students every five years. This gives us a broad overview of performance. The chair also tracks any curricular issues that appear in the student assessment of instruction course reviews.

Another useful source of data is the senior exit interview. Seniors meet with the departmental advisor mentor during the last three weeks of their final term for a structured interview. The majority of the questions are directly linked to the departmental outcomes. This gives a good overview of the student's perceptions of how well we are meeting the outcomes.

SUPPORT

We have used as much automation as possible in order to track the information. A Microsoft Access database houses the list of courses, coordinators, mappings between course outcomes and departmental outcomes, and rubric schedules. The system can create term-by-term schedules of assessment activities and course reviews. All assessment forms and reports are housed on a shared server. The server also contains an archive of course materials and advising documents. In addition the course level rubrics are implemented as Microsoft Excel spreadsheet work books that automatically tally results and generate graphical representations of each year's assessment activities. This automation of routine tasks has helped to lessen the burden on individual faculty and the assessment committee.

VISIBILITY

To keep the issues of assessment as part of everyday activity in the department, a few initiatives besides reports from the assessment committee have been undertaken. First, one or two of the course reviews mentioned above occur at just about every faculty meeting. A short outline of the process, including "Cliff Notes" on assessment, has been prepared to help orientate new faculty (see Appendix IV). The department displays posters of the departmental outcomes in all our classrooms and hallways. Additionally "customized" versions of these posters with a humorous extra outcome tailored to a faculty's hobbies or persona are also available.

EVOLUTION OF THE PROGRAM

The planning of the formal assessment program was led by the department's assessment committee. This committee included faculty from all of the concentrations and contained both tenured and un-tenured faculty of all ranks. It was led by a tenured full professor to ensure no conflicts of interest occurred. While this committee did the planning, the outcomes and objectives came from the faculty themselves. Initially, a call went out to all faculty to e-mail the committee a list of ten skills they felt our students would possess at graduation. The committee then did a similarity study on the results and condensed the responses down to a list of about 20 potential student outcomes. These were then taken to a special afternoon long faculty meeting in which they were tuned (tweaked), presented to our advisory board for review and revision, and then adopted.

The most recent revisions to the program took place in 2005. The chair of the committee reviewed the new ABET-CAC criteria [3] with respect to the department's existing program and reported back

to the committee and the departmental chair. The committee then planned a set of revisions to bring the program into line with the new requirements. The resulting tasks listed below were also viewed as an opportunity to simplify and streamline the assessment process.

1) Revise the department's program goals
   a. Identify which of the existing departmental goals are student outcomes or objectives.
   b. Correlate these with the new ABET-CAC common criteria and the program- specific criteria.
2) Revise the data collection process to ensure it is efficient, understood by the faculty, and aligned with the curriculum
3) Revise the curriculum revision process to ensure it is efficient, understood by the faculty, and aligned with the curriculum.

Two faculty members took the lead on mapping existing goals to shared outcomes, objectives, and the ABET A-I criteria. A third then reviewed and integrated their work. By examining the reports, the committee could easily see the commonalities, and each reviewer served as a check on the other, finding mappings the other had missed.

With the common outcomes and objectives set, the next task was to define outcomes for the individual Computer Science and Information Technology programs. The committee examined the courses that were specific to each concentration and their course outcomes, to find the skill sets unique to each.

The committee reported to the faculty requesting a discussion of the findings in advance of the next faculty meeting. This discussion took place on the departmental listservs. This approach was taken due to the fact that little was changing in the skills being assessed. It was mostly a case of reorganizing and rewording the existing goals into outcomes and objectives that better matched the ABET-CAC model. The electronic approach ensured all faculty members saw the outcomes and objectives and had a chance to comment and suggest revisions if they desired, but did not unnecessarily impinge on their time. Several changes did arise and were incorporated. Using this method it only took about ten minutes at the next regular faculty meeting to review and accept these changes.

The new outcomes then needed to be linked to course attributes to establish an assessment plan. Ideally the lead instructors for each course would undertake this mapping. Unfortunately time constraints do not always permit this. An alternative approach was found that seems to have been effective. Since the department had course outcomes and mappings from these to the old program goals, a small group of the assessment committee built a mapping between old goals and new program outcomes and then updated the course syllabi outcomes using this mapping. Then these annotated syllabi were distributed to the lead instructors to be verified and edited. Since the time demand on verifying and editing was much less than a full rework of the schema, this approach was well received by the faculty, and a very high participation rate was achieved.

CONCLUSIONS

The Computer and Information Sciences Department at East Tennessee State University has evolved a system of assessment to support improvement in our curriculum and the needs of accreditation. As with most programs, the setup was a challenge, but we are coming to realize that the bigger challenge is maintaining the level of interest and support for the program on a day-to-day basis, and the introspection needed for closing the loop [5]. That challenge is still ongoing for all of us.

REFERENCES

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APPENDIX I

OBJECTIVES AND OUTCOMES

Skills students will have for life

1. Each graduate of the department will be able to communicate effectively.
2. Each graduate of the department will be able to understand the Computing Body of Knowledge and apply it to real world problems.
   a. Each graduate of the department's Computer Science Concentration will be able to understand and apply the theoretical basis of computer science to real world problems.
   b. Each graduate of the department's Information Sciences Concentration will be able to understand and apply the Computing Body of Knowledge within the context of business applications.
   c. Each graduate of the department's Information Technology Concentration will be able to understand the Computing Body of Knowledge and apply it to build and support systems that solve real world problems.
3. Each graduate of the department will be able to function as an effective member of a software engineering team.
4. Each graduate of the department will be able to understand and accept the ethical, social, and legal responsibilities of the computing profession.

Skills students have at graduation

Shared Outcomes

1. Each graduate will be able to perform well as part of an organization. (ABET d, f)
   a. Each graduate will possess good oral communication skills. (ABET f)
   b. Each graduate will possess good written communication skills. (ABET f)
   c. Each graduate will be able to perform as an integral part of a team. (ABET d)
2. Each graduate will be able to perform well as a part of society. (ABET e, g, h)
   a. Each graduate will be able to recognize, discuss and answer questions about a broad range of social, ethical, legal, global and professional issues in the computing field. (ABET e, g)
   b. Each graduate will be prepared with the skills necessary to become life-long learners. (ABET h)
3. Each graduate will possess core knowledge of computer fundamentals. (ABET i)
   a. Each graduate will understand and apply database management systems. (ABET i)
   b. Each graduate will understand computer networks and networking. (ABET i)
4. Each graduate will possess problem solving skills. (ABET a, b)
   a. Each graduate will have knowledge of the theory and application of discrete math. (ABET a)
   b. Each graduate, given an end user problem statement, will be able to completely and accurately identify the requirements, resources and approaches needed to implement a solution. (ABET b)
5. Each graduate will possess the ability to create computer-based solutions. (ABET c,g)
   Each graduate will understand the software life cycle. (ABET c, g)
   Each graduate will understand how security issues impact his or her solutions. (ABET g)
   Each graduate will be able to use classic and current tools to implement a solution to a given problem. This includes knowledge of two programming languages and mastery of at least one. (ABET c)

Concentration Specific Outcomes

CS-1 Each graduate of the Computer Science Concentration will apply his or her knowledge of the theoretical basis of computation, computer architecture and systems software in the design of systems and applications. (ABET CS-j)

CS-2 Each graduate of the Computer Science Concentration will have the ability to develop software systems by using established principles and techniques for systems analysis, design and implementation. (ABET CS-k)

IS-1 Each graduate of the Information Sciences Concentration will be able to create and maintain systems that support the business processes in a management or accounting environment.

   a. Each Graduate will be able to apply best practices in accounting or management. (ABET IS-j)
   b. Each Graduate will be able to select, customize, and integrate software needed to support accounting or management infrastructure. (ABET IS-j)

IS-2 Each graduate of the Information Sciences Concentration will understand the software development process with a view towards managing software developers. (ABET IS-j)

IT-1 Each graduate of the Information Technology Concentration will be able to plan and implement web applications that conform to industrial standards using current tools and technologies. (ABET IT-j, IT-k, IT-m)

a. Each graduate will be able to design, implement and manage a secure server side web application with broad user interface capabilities. (ABET IT-j, IT-k, IT-m)
b. Each graduate will be able to plan and create successful web applications congruent with the needs of the target audience and the objectives of the client. (ABET IT-j, IT-k, IT-m)

IT-2 Each graduate of the Information Technology Concentration will be able to design, implement, and administer heterogeneous networks, clients and servers using current tools, utilities and scripting languages that conform to industrial protocols and security standards. (ABET IT-l)

IT-3 Each graduate of the Information Technology Concentration will be able to integrate human computer interaction (HCI) techniques to applications with a solid understanding of HCI's critical role in software engineering. (ABET IT-k)

APPENDIX II

SAMPLE RUBRIC FOR AN OUTCOME

Rubric for Outcome 3a Each graduate will understand and apply database management systems			
Each graduate will build efficient, maintainable SQL queries to retrieve information that fulfill stated requirements from existing databases			
	Does Not Meet Expectations	**Meets Expectations**	**Exceeds Expectations**
Efficient			
Minimal use of Joins	More than one extraneous table ☐	One extraneous table ☐	No extraneous tables ☐
Minimal use of Nested Queries	More than one extraneous sub query ☐	One extraneous sub query ☐	No extraneous sub query ☐
No extraneous code	More than one un-needed clause ☐	One un-needed clause ☐	No un-needed clauses ☐
Minimal use of dynamic tables	More than one un-needed dynamic tables ☐	One un-needed dynamic tables ☐	No un-needed dynamic tables ☐
Optimal use of non standard extensions	Extensions never used when available ☐	Extensions used in some places when available ☐	Extensions regularly used when available ☐
No repetitions of query sub elements	More than one repetition ☐	One repetition ☐	No repetitions ☐
Maintainable			
Code indented correctly	Code not indented at all ☐	Code indented in most cases ☐	Code always correctly indented ☐
Columns cited with TABLE.COLUMN style	Correct style never used ☐	Correct never used in most cases ☐	Correct style always used ☐
Comments included	No comments ☐	Some comments explaining approach ☐	Full documentation ☐
Aliases used for description	Never used ☐	Used in most cases ☐	Always used ☐
Keywords and Tables use different capitalization schemes	Never used ☐	Used in most cases ☐	Always used ☐
Fulfills Requirements			
Code is executable	No ☐	Minor error (missing ;) ☐	Runs ☐
Code retrieves correct data from sample set	No ☐	Yes, but minor math or format error ☐	Always ☐
Code handles NULLs correctly	No ☐	In most cases ☐	Always ☐
Code written to handle exceptional cases	No ☐	In most cases ☐	Always ☐

APPENDIX III

TRIENNIAL COURSE REVIEW FORM

Course: CSCI 4127/5127 Database Management Systems 1
Prereqs: CSCI 2020 and either 2910 or 2210
Feeds: Database 2, Senior Capstone
Needed Skills:
Basic SQL
Basic Modeling Techniques
Problem Decomposition
Basic Algorithm Design
Outcomes: At the conclusion of the course a student will be able to:

- Understand and create databases using the relational model (Student Outcome 3a*)
- Design ER diagrams based on simple database specifications (Student Outcome 4b)
- Design and implement complex queries, and updates using the ISO standard SQL language (Student Outcomes 3a*, CS-2*, IT-1)

Deliverables: There are roughly 8 labs and 8 homeworks with the ith homework and lab covering roughly the same material. There are also three in class exams. Graduates enrolled in this course complete a significant research project. The deliverable is either a working piece of code with documentation, or a formal report, or both.

Metrics Used: For the last three years direct assessment data has been collected. In 2004-2005 92% of the students performed at 70% or better on selected exam questions, in 2005-2006 it was 92.5%. Those numbers were re-assuring but did not give direction for course improvement. In 2006-2007 this course piloted the use of a grading rubric. The rubric was applied to a set of questions from an in-class lab. The results were 91.66% meeting or exceeding expectations. However this time it was noted that on 76% of the students met or exceed expectations for documentation, and there was a 10% failure rate on the handling of nulls and exceptional cases. The latter is not too surprising in a timed lab; however the lack of documentation was disconcerting. This year the grading rubric for the lab will be discussed several times in class, and the expectations for documentation will be emphasized. It is hoped this will bring up that underperforming area.

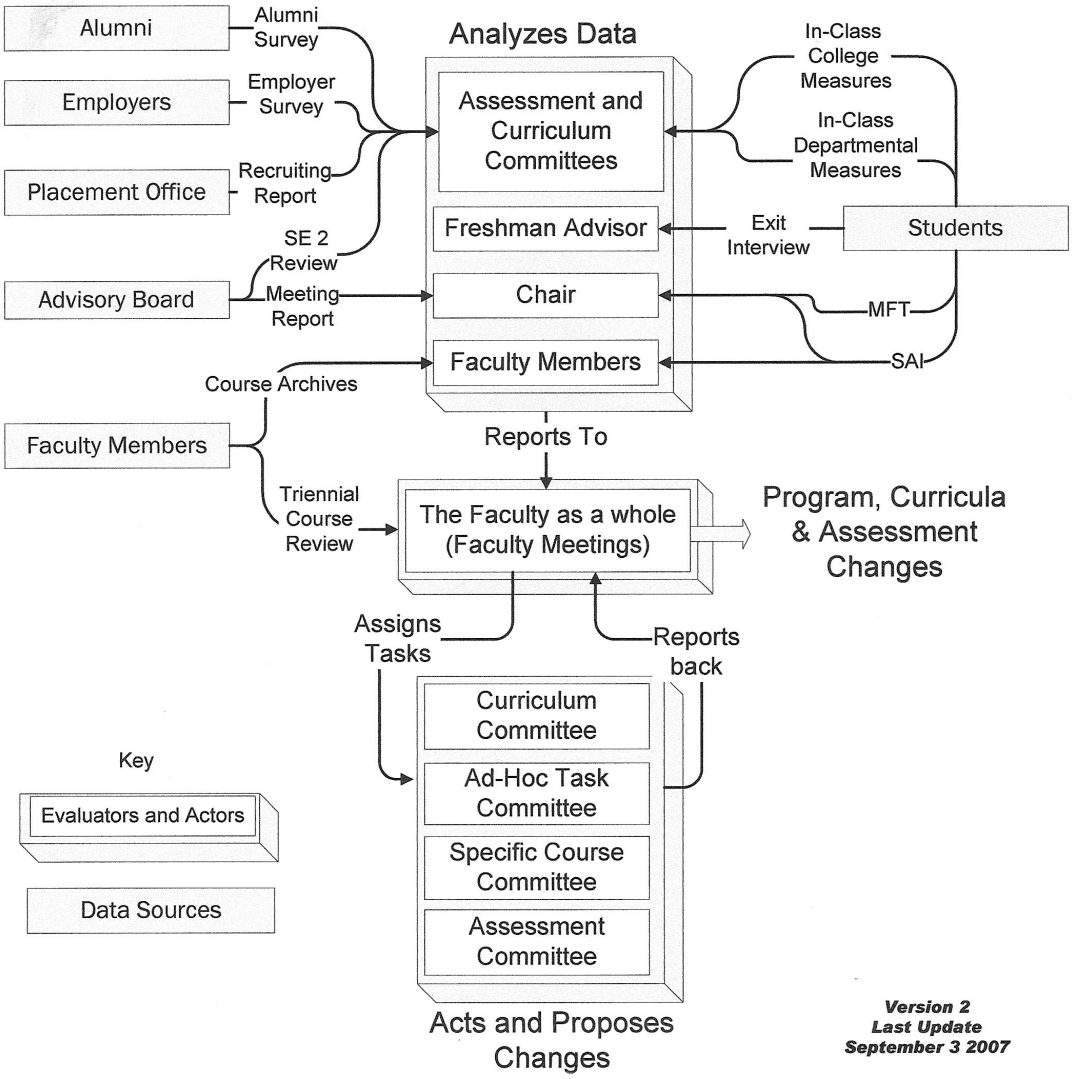
Changes Since Last Report: The biggest changer was the addition of an integrated lab component to the course. This three hours course meets for 4 hours each week, and this allows for the integration of six 2 hours sql labs, and three design labs in the course. Direct assessment data indicated no real change in comprehension, but the SAI's have indicated increased student satisfaction.

Future Plans: As a result of the introduction of 2020 major changes are planned for the near future. This course will cover the more theoretical topics in the current DB1 that did not migrate to DB Essentials (Formal Relational Model and Functional Dependencies), DB Design (ER Diagramming, Requirements Elicitation, and Normal Forms), as well as advanced SQL (Correlated Queries, Cube and Rollup, Data Conversion Functions, Constraints, Triggers, and Stored Procedures). It may also add XML interfaces and/or query optimization techniques. An approach we have thought of here is to use two or three group projects per class. We would start with each group working on their own project all using 1 DB language (Oracle, DB2, SQL Server or MySQL) as the advanced features of that language were taught in class. At about week 8 we would swap around the projects and have each group re-implement another groups project using a different DBMS. This would let us cover 2 types of systems and teach the students about portable and non portable code. It would also show them just how much all DBMS's have in common via SQL. Offerings of this course should be 2–3 sections per year.

APPENDIX IV

ASSESSMENT CLIFF NOTES

a) The Process



b) Key Faculty Activities

Course Reviews in Faculty Meetings and Archive Course Materials

Assessment Cliff Notes (2)

Why do we do this?

The only REAL reason to do assessment is to make our courses better for our students. The data collected should guide when/how/why we make changes in courses and curriculum.

What do we do?

- **Direct measures of student performance:**
  - **In our classes:** Some of the rubrics used are ours, and others are part of the College-wide program. The schedule for this is on csadmin
  - **By the advisory board on SE2 presentations**
  - **MFT**
- **Indirect Measures:**
  We use the exit interview, employer and alumni surveys for this.

- **Archive Materials:**
  Sample materials from each course taught are saved every year for future use and examination.
- **Review Courses:**
  Once every three years each course is discussed at a faculty meeting. The schedule for this is on csadmin.
- **Use the Data Collected:**
  If you are thinking about a course change or curriculum change, look back at the data collected. It resides in the assessment directory on csadmin.

What do I have to do as a faculty member?

- **Use the Data:**
  The csadmin share is a treasure trove of past assessment, coursework, advising materials and other data. Use it when making course and/or curriculum decisions, and *document* your use of the data.
- **Archive Course Work:**
  When the term is over, talk with the course coordinator, and populate the course archive folder on csadmin with your course materials.
- **Collect Direct Assessment Data:** Certain courses take direct measures of student performance on a three year cycle. The Assessment Committee Chair will contact you if the course you are teaching is collecting data. The rubrics to use are on csadmin.
- **Give Course Reviews:** The Curriculum Committee Chair will contact you if the course you coordinate is to be discussed that term. When preparing the review use the template on csadmin to build your report. Pay special attention to the section on the use of assessment data to decide on changes.
- **Participate in discussions:** The listservs give us records of our decision making, use them.
- **Use and Update Master Syllabi:** The outcomes on these syllabi are what other faculty and the students are looking for, so base your syllabus off the master. If the master looks wrong then we (as a faculty) need to update it. All master syllabi are on csadmin, and our web site.
- **Track Updates:** Changes to courses, curriculum and degree requirements change the assessment process. Bring the assessment committee into the process early.
- **Assess Assessment:** Remember that the assessment process is *OUR* process. If something is not right we can change it. Just say something! It can be changed. The whole point of doing assessment is to collect the data we need to make our courses better.

Donald B. Sanderson is a professor in the department of Computer and Information Sciences at East Tennessee State University, where he also holds the Eldridge faculty fellowship in the College of Business and Technology. He has been involved in educational outcomes assessment for the last seven years, serving as his department's assessment leader. He is a qualified program evaluator for ABET's Computing Commission, a frequent presenter at ABET's Best Assessment Processes Symposium, and a member of the inaugural IDEAL scholars assessment training program. His specialty is the application of commercial off the shelf software to solving assessment data tracking.