Crossing the Bridge: ABET Accreditation

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Abstract
Accreditation of computer science and related programs has become of great importance to the academic institutions in order to ensure a higher quality undergraduate program in compliance with standards. This paper summarizes various activities and approaches that were adopted for program review and assessment by SETM leading up to the completion of the ABET self-study report for BS in Computer Science program. Some activities focused on making our onsite and online programs unique and more appealing to both traditional and non-traditional students. Accreditation is a non-governmental, peer reviewed process that ensures educational quality. Educational institutions or programs volunteer to periodically undergo this review to determine if minimum criteria are being met. Accreditation verifies that an institution or program meets the criteria, ensuring a quality educational experience. ABET accredits programs in Computer Science, Information Technology and Engineering. ABET accreditation helps institutions establish high quality programs along with processes for continuous improvements. Currently ABET is the only accrediting agency for Computer Science programs. In this paper we will examine the impact of our preparation for ABET accreditation on the curriculum as well as assessment process. We also include an overview of our assessment process, assessment instruments and curriculum changes.

Introduction

National University (NU), an independent, nonprofit institution of higher education, has dedicated itself to providing educational opportunities to a diverse population of working adult learners since 1971. The School of Engineering, Technology and Media (SETM) at National University was established in July 2002, and has attracted a current student body of over 1300 whose profile generally mirrors that of the university itself. NU, the second largest private non-profit university in California, has over 23,000 mainly non-traditional students: students whose average age is over 30. The university also boasts of a large population of students from traditionally underrepresented groups, such as women and minorities. Typically, most of these students, whether at the undergraduate or graduate level, are re-entering an academic environment after having been out in the working world for some time. SETM offers nine undergraduate and eight graduate degree programs with several specializations. Over 90% of these programs are offered both in the online and on-ground modes. SETM has over 10 years of experience in online education. The undergraduate computer science program at NU was first offered in mid 1980s and since then the curriculum has been through some significant changes. The program was first offered entirely online in 2006 and currently has a strong online presence. Few years ago STEM decided to pursue ABET accreditation and mobilized faculty to examine the CS curriculum and its assessment process in order to align the program with ABET requirements.

ABET Criteria

ABET provides a form of quality assurance for the undergraduate academic programs[6]. It consists of four accreditation commissions namely, Applied Science (ASAC), Computing Science (CSAC), Engineering (EAC) and Engineering Technology (ETAC). Each commission covers a specific sector of the technical disciplines and is responsible for policies, procedures and criteria that apply to that discipline. Commission members make final decisions about all program accreditation actions. The CSAC has two types of criteria, the "general criteria" and "program criteria" that is specific to a particular degree program. The eight general criterions address requirements related to a) Student, b) Program Educational Objectives, c) Student Outcomes, d) Continuous Improvement, e) Curriculum, f) Faculty, g) Facilities and h) Institutional Support. The program specific criteria address a) student outcomes, b) the overall curriculum and c) faculty profile. Among the CSAC policies and procedures are the requirements that each ABET-accredited program must publicly state the program's educational objectives as well as student outcomes, they must also publicly post annual student enrollment and graduation data for the program.

According to ABET, programs that seek initial accreditation must submit a readiness review report; this is a preliminary self-study report. The template for this self-study can be downloaded from the ABET site. The ABET accreditation process takes about 18 months, and it begins by the submission of the preliminary self-study report or a Request For Evaluation depending on whether the application is for initial accreditation or a renewal of accreditation. However, at least a year before formal submission, the program must have in place processes for assessing program educational objectives and student outcomes, there must also be procedures in place for collecting student sample artifacts to present to the ABET reviewing team during campus visit.

Preparing for the Accreditation

The computer science program at NU is offered online as well as onsite and two the programs are identical. Contacting ABET office we were informed that we needed to submit only one self-study report for the online and the onsite programs. Among the first actions we took was to form an advisory board for the program. The advisory board consisted of five industry experts, two program alumni plus CS faculty. A mission for the advisory board was developed and periodic meetings were scheduled to discuss the program. Although the CS program at NU had a set of Program Learning Outcomes, it was decided to adapt the ABET proposed students outcomes with some revisions. A set of Program Educational Objectives was also developed by the advisory board and was integrated into the CS program and queued for assessment. The original CS program was not compliant with ABET Criterion for curriculum; it lacked math and science components. It took about a year to revise the curriculum and took it through appropriate university committees for approvals. The revisions consisted of development and addition of a lecture and lab course in Scientific Problem Solving as well as courses in Linear Algebra, Probability and Statistics, Computer Ethics, and Physics/Chemistry. The Curriculum is now compliant with the ABET criteria and will soon produce its first set of graduates.

Significant efforts were placed in development, delivery and assessment of online courses in the CS program. Online courses explicitly list Program Learning Outcomes (PLOs) or Student outcomes as ABET calls them. All Instructors are encouraged to teach and assess students

relevant to those outcomes. Online CS classes, like the onsite class, run for four weeks. All online classes are required to hold two chat sessions per week, each for at least two hour. Chat sessions are support by the voIP and application sharing systems. Faculty teaching online use tablet PCs with inking capability that facilitates a virtual environment that's very similar to the physical classroom. Online classes are highly interactive with both synchronous and asynchronous learning activities. Instructors use their tablet to deliver their lectures and conduct discussions and problem solving sessions[1,4]. All chat session are recorded and can be viewed by students at a later time.

Program Annual Review

At NU all programs must complete the Program Annual Report (PAR) that focuses on assessing Program Learning Outcomes (PLOs) and provides recommendations on ways to improve student learning and class experience based on analyzing multiple levels of assessment measures. As part of the initial degree program design individual PLOs are mapped to required courses in the program. This course mapping also marks each PLO as Introduced (I), Developed (D) or Mastered (M) in a given course. Each PLO must be mastered in at least one course. PARs assess student learning in both teaching modalities of onsite and online. Each measure is assigned an "acceptable" and an "ideal" target level prior to the actual assessment. A student achievement on each measure is compared against the acceptable and the ideal targets and recommendations are made for program improvement. The use of multiple-assessment measures is encouraged and widely exercised at National University. Both qualitative and quantitative data collection and analysis are critical components of the PAR. Commonly used measures for assessment purpose are student scores on exams or particular questions in an exam, student portfolios, signature assignments, program exit interviews and surveys conducted of students and alumni. PAR recommendations are presented to the school dean for comments before it is forwarded to the Undergraduate Council at NU for the final review.

Five Year Review

The Five-Year Program Review is a collaborative effort of the program lead faculty and faculty members who primarily teach in the program. As the name implies it take place every five years and provides an opportunity to examine historic data relevant to the program and identify trends. The Five-Year Program Review is based on inquiry where lead faculty develop a set of overarching questions that leads to program improvements. An attempt to collect evidence and respond to the overarching questions is one of the objectives of the review. External reviewer's experts in the subject are invited to review the program and provide feedback. Trend analysis of from prior PARs and comments from the external reviewers form the basis of the Five-Year Program Review. Institutional data relevant to the program such as student and faculty demographics as well as retention/graduation rates are analyzed and reported. Assessment results are compared with assessment objectives identified by the lead faculty over the five year period. The Five-Year Program Review requires faculty to reflect on factors influencing student success in the program and provide comments. The program lead and the department chair are asked to analyze student retention and graduation rates. The results from the Five-Year Program Review as well as the suggested action plans and resource allocations for the program are itemized in a Memorandum of Agreement that requires approval by the school Dean and Provost.

Assessment Methods

The assessment plan includes direct and indirect measures for evaluating the achievement of program learning outcomes. Each PLO requires two direct and one indirect measure for the purpose of triangularization.

- **Direct measure –** Individual items imbedded in course assignments or exams are used to assess specific program learning outcomes. The Program Lead faculty and the individual faculty member teaching the course will develop the items. PLOs are assessed at key points in the curriculum to determine the level of learning (Initial, Developed, Mastered).
- **Indirect measure –** Upon completion of the program students participate in an exit survey in which they are asked to rate themselves on the achievement of PLOs. This affords an opportunity to evaluate the extent to which students have acquired the skills and knowledge outlined in the program learning objectives. Periodic surveys in individual classes provide more focused data collection.

Assessment Process

In general, the purpose of assessment at National University is to continually improve and ensure the quality of the programs, assessment also aids in allocating funds and other resources within the school. Since assessment is handled at various levels, it is critical to have a solid assessment plan that effectively evaluate success and allow for the assessment to be completed within time. It should also provide information on student accomplishment in the program.

The assessment process for our programs is handled at various levels and by different committees consisting of faculty and administrators. Assessment starts with the program lead, who is a full-time faculty responsible for the curriculum content and its relevance and quality. Lead faculty is given other critical duties such as staffing classes, review faculty evaluations and student assessments, initiating curricular changes to name a few. Lead faculty reports to the department chair and require chair's approval for curricular decisions. Program lead faculty develops (multi-year) assessment plan and produces the annual PARs. The lead faculty is also given the task of planning and completing the Five Year Program Review. Members of the School Assessment Committee (SAC) provide assistance and coaching to the lead faculty in the preparation of the various components of their PAR for their programs. The PAR reports are entered and archived in a web accessible central system known as Task Stream Accountability Management System (AMS). In 2008, National University acquired the AMS system to support the assessment process. AMS provides a mechanism for tracking recommendations and action plans recommended for a program. The Curriculum Map, Multiyear Assessment Plan, as well as all assessment findings and recommendations are archived in the AMS system. SAC coaches inspect the content and completeness of the PAR on the AMS and provide feedback to the lead faculty, which is entered in the system. The completed PAR is then reviewed by the department chair and school Dean. The PAR is next submitted for approval to the Undergraduate Council that has its own Assessment Committee that review PARs and add comments and assign a score (Initial, Emerging, Developed or Highly Developed) based on the rubric provided for each section in the PAR. The chair of the committee then presents their findings to the Undergraduate Council and seeks Councils approval. Figure 1 show the cycle each program PAR is routed through.

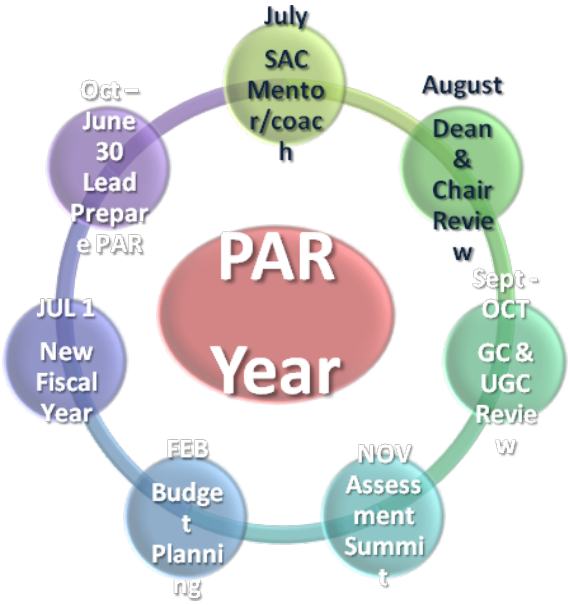

Figure 1. PAR review cycle.

Figure 2. 5-year review cycle

A five-year program review process goes through the same review and approval process as PARs. Figure 2 shows the cycle for a typical Five-year Program Review cycle. The advantage of the National University assessment cycle is that it:

- Exists in relationship to the Mission, Core Values, Strategic Planning, Five Year Program Review, and the Assessment Summit.
- Evolves as a systematic yearly planning and review process consistently used by all schools and departments.

- Contributes to a comprehensive, University-wide approach to assessment. Multiple methods of data collection and analysis of student learning are used to assess progress towards achievement of learning outcomes and to make informed decisions regarding change.
- Provides for regular and ongoing opportunities for faculty engagement and reflection based on learning results.

Presentation of Results

The PARs include analysis results and comments viewable by all program faculty, administrative members as well as the members of the Undergraduate Council. The University implemented Taskstream's AMS system as a collaborative work environment and a repository for recommendations from preceding years. Assessment data, analysis, findings and recommendations for each program are presented at the Annual Assessment Summit held at NU where the NU community gathers to present, discuss and learn about all aspects of assessment.

In a recent Assessment Summit the CS program presented its Alumni survey. The survey was conducted by the University's Office of Institutional Research and Assessment (OIRA). The most recent survey in CS was conducted in June 2010, this was a 13-item survey. The survey questions were internally created in the department and were designed to collect data on items relevant to ABET accreditation. Survey mailing and administration as well as report generation were all conducted by the OIRA. The 2010 survey was the first formal survey of graduates conducted in our department to gather information on the student experience at NU and the level at which program educational objectives were achieved. The initial levels of attainment for educational objectives were set at 70%. Results of the 2010 graduate survey indicate that 88% of the graduates were employed in a computing field. About 23% of the students had membership in some professional organization. About 27% of the graduates were involved in community service activities. And finally, about 23% of the graduate stated that they received some noteworthy recognition or award since graduation. The survey results were shared with the program advisory board members and it remains archived as assessment document for BSCS program.

Assessment Instrument

NU's Assessment process consists of PAR that is completed every year and a program review that is done every five years. About 20% of the PLOs are assessed each year; the idea is to assess all the PLOs by the time a five year review is to be conducted. The NU standard for assessing a PLO is to use two direct and one indirect measure. The standard also requires the program lead faculty to establish a baseline by stating the "acceptable and ideal target" in terms of student performances. Supporting documents, mostly consisting of student artifacts, are collected as evidence of student success. The assessment planning requires a "Multi-year Assessment Plan" indicating when and in which course each PLOs is to be assessed in the coming years. "Assessment findings" is also a part of each PAR, it details findings for each outcome. Other sections of PAR include Overall Reflections, Implementation of Changes from the Last Program Assessment and Implementation of Changes from the Last 5-year Review. The last section in PAR is the "Overall Recommendations and Requests for Resources". The last two items are, basically, an attempt to close the loop for the assessment cycle and to initiate implementation of approved changes, if any.

A major effort goes into completion of Five Year Program Review. The report is produced by a committee of faculty who teach in the CS program. The report starts with a section on "General Information" about the program that includes a timeline for the "Assessment Plan". The plan details actions to be taken and tasks to be completed, individual committee members are given different responsibilities leading to the collection of assessment data, its analysis and final reporting. The Five Year Program Review is examined by two external reviewers that are invited by the lead faculty to review the report and provide feedback. The reviewers are subject matter expert. The Five-year Program Review consists of 12 sections in total. There is a section that provides detailed information about the program as well as sections about the relevancy of the program, the currency of the program, faculty qualifications, their preparedness and academic support, student achievement, academic success of students, program vitality, adequacy of resources, additional information, summary of recommendation, and the report from the external reviewers.

Monitoring Student Performance

The academic progress in the program is assessed by the cumulative grade point average (GPA) achieved at National University. A student must maintain the minimum GPA of 2.0 to make satisfactory academic progress in the program. Students whose cumulative GPA falls below 2.0 are placed on academic probation. The chair and the lead faculty for the program periodically receive a list of most recent students placed on the probation. Student progress is also monitored by their admission advisor assigned to them when they enroll in the program, and the lead faculty for the program. As students make progress through the program, the Annual Activity Report (AAR) will show coursework already completed and courses remaining to be completed. The AAR helps students, advisors, and the registrar office determine progress toward the completion of program requirements and also serves as a graduation check. The lead faculty reviews students' schedules and course grades on a quarterly basis and contacts appropriate admission advisors if adjustments are needed.

Student Advising

Upon admission to National University each student is assigned an admission advisor that advises the student on University policies as well as assisting them on planning a course of study for the entire program. Admission advisors are trained on all university programs and understand the requirements for individual programs. Each student also has an academic advisor who is the lead faculty for the program. Admission advisors continue to advise students as they go through the program. Students often contact their admission advisor when they need assistance or clarification of certain rules or regulations; often admission advisors submit requests (for example, an independent study request) on behalf of students for approval. The request is submitted electronically (e-form) through SOAR. Admission advisors are available during normal business hours, students can either make an appointment to visit their admission advisor or contact them via email or a phone call.

Upon admission to the University, students may contact their lead faculty to assist them in making appropriate decisions about their educational or career path. The lead faculty provides students the benefit of experience in professional practice and insight gathered from years of experience in the industry and/or in higher education. The lead faculty for the Computer Science program reviews student grades and their plan of study on regular basis to make sure they are

meeting all program requirements and are on track for graduation. Lead faculty advise students on curriculum content, course requirements, proficiency examinations, and program goals. Student schedule and grades are available to the program lead electronically through SOAR.

The initial set of Program Educational Objectives was derived from the mission of the University, Program Learning Outcomes, and Institutional Learning Objectives. The proposed objectives were recently reviewed, discussed and approved in the Program Advisory Board meeting on October 2011 consisting of industry experts, faculty and graduates of the program. Our plan is to examine the current set of objectives every two to three years in the Advisory Board meetings. The survey results from our graduates along with our industry advisors will play a major role in guiding future additions/deletions or revisions of the program educational objectives.

The eight PLOs in the computer science program embody the knowledge and skills expected of our graduates immediately after graduation. To ensure graduates have adequate opportunities to master student outcomes, the PLOs are mapped to individual courses on a Curriculum Map. Each course in the CS program has a set of learning outcomes that address one or more of the PLOs. The CS program has a Multiyear Assessment Plan that gives a list of PLOs to be assessed each year and the courses to be used for their assessment. The assessment plan also specifies the instrument(s) to be used for assessment. The assessment plan, its findings and recommendations are documented and reported annually in a Program Annual Review (PAR). The PAR reports are entered and archived in a web assessable central system known as AMS (Task stream Accountability Management System). In 2008, National University acquired the AMS system to support the assessment process. AMS provides a mechanism for tracking recommendations, action plans, and results from year to year. The Curriculum Map, Multiyear Assessment Plan, as well as all assessment findings and recommendations are archived in the AMS system. The PAR report is reviewed by the Chair and school Dean, and the University Assessment Committee.

The one course per month nature of the National University (accelerated format) provides opportunities to assess student learning outcome on regular basis multiple times per year given the availability of time and resources. The Computer Science department is still trying to find the optimal frequency for assessing PLOs. Currently we assess each PLO at least once for each cohort of students that go through the program. At any given time, there are from two to four cohorts of students at different stages of the program; this includes the online cohorts as well. The summary of the assessment results are presented in this section.

As a baseline we have decided to set the expected level of PLO attainment for each student at 70%. We plan to gradually increase this level. Recent assessments have produced Introduction of Smarthinking online tutorial in courses with mathematics content – University allocated close to $10,000 to contract Smarthinking online mathematics tutorial for our students. The rational was to help improve student performance in mathematics classes. Many of our students enter the program with weak math skills and perform poorly. Many drop out of the program due to weak performance in mathematics (and programming). SETM decided to provide a free online tutorial for students taking mathematics classes. Unfortunately the approach was not successful; the tutorial was not popular with students. The reason could have been the text based chat system. No formal study was done to find out why the tutorials were not successful. Review of

simulation software for CSC340L – Digital circuit lab resulted in a change. The Xilinx software proved to be too complex and overwhelming to be utilized in our classes. The simulation tool was replaced by MultiSim from National Instrument. Providing free tutorials for all 200 level CSC courses – we have received approval to experiment with providing tutorial session for our students. The object is to have either graduate students or our adjunct to be available to help students in lower level CS classes.

Conclusion

This paper provides a summary of approaches adopted by SETM from the design, development and implementation of assessment plans for its CS degree program to prepare the program for the ABET CS accreditation. Steps taken to make the program compliant with ABET criteria are presented and some factures to enhance the online program are discussed.

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