Assessment Model and Practices for Computing and Information Systems Programs

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Abstract

Assessment is a topic that has received an increasing interest in universities and colleges over the past several years. A major reason for assessment is accreditation of universities, colleges, and programs. The assessment practices and requirements are very broad and vary widely among academic programs and from one institution to the other. This paper presents and explains an assessment model and a set of robust tools and techniques within the framework of process steps, team work, and task-driven process management. Using this presented assessment methodology, we have been successful in our accreditation efforts, and improved the quality of our programs. We share our views and thoughts in the form of lessons learned and best practices so as to streamline the process of assessment and simplify its procedures and steps.

Keywords: Assessment, Assessment model, Assessment tools, Information Systems programs, Accreditation

1. INTRODUCTION

Motivation: Assessment practices and requirements are very broad and can be interpreted and applied in many ways. In this work, the main motivation is to tackle an assessment process and present a well specified assessment model and set of tools with the framework of process steps, team work, and project based task. Moreover, this work can be viewed as a way to share and disseminate

our work practices, findings, and lessons learned in an assessment task.

Background: For an educational accreditation purpose, a certain form of assessment is typically mandated by a national or regional accreditation agency such as ABET, AACSB, and SACS, with the main responsibility of maintaining the standards for degree confirmation. An assessment process can be viewed as a simple and direct evaluation of an academic program or discipline in an educational institution. Assessment can be accomplished at various levels. Typically three levels of assessment can be distinguished:

- Institution-level assessment,
- School-level assessment, e.g. school of business, or school of education
- Program-level assessment, e.g. information systems program or accounting program.

Program-level assessment is the focus of this paper.

Reasons for Assessment: Reasons for assessment can be grouped into three major categories: (1) to satisfy external accreditation requirements at various levels: university, school and program; (2) to satisfy internal requirements of the university, such as periodic program reviews, etc.; and (3) to utilize the results internally to improve the programs or for recruiting and marketing purposes.

Goals of This Paper: This paper presents and explains a set of robust and compressive assessment guidelines for computing and information systems fields. We designed and implemented a comprehensive assessment methodology for two computing programs. We started with the mission statement and streamlined the main objectives of the programs. The method includes a comprehensive and solid set of measurable goals and outcomes. The results of applying this assessment methodology are then taken into the last phase which is known as 'closing the loop'. In the closing the loop phase, we take the assessment results and apply the recommendations to improve the quality of the programs. We have been using this presented assessment methodology for several years and it has helped us to improve the quality of our programs. Moreover, this assessment method has helped and simplified the accreditation process of two computing programs by ABET under the IS and CS curriculum guidelines.

2. LITERATURE REVIEW

Faculty who recognize the advantages of an accredited program are familiar with curriculum models and accreditation requirements. Landry, et al. (2009; 2006) discuss the Information Systems (IS) 2002 model curriculum and how 150 learning units are mapped into 6 IS core areas. The model curriculum is a result of a collaborative effort that describes the characteristics of the IS profession.

Hilton, et al. (2003; 2004) conduct a comparison of the school-level Association to Advance Collegiate Schools of Business (AACSB) and program-level ABET/CAC accreditation standards. They find AACSB and ABET/CAC accreditation standards generally compatible. Based on a survey of IS program leaders in business schools, understanding of potential benefits of accreditation are quite low. Challa, et al. (2005) find that much of the requirements of ABET, including assessment, is applicable to IS programs.

Nicolai (2004) addresses the dilemma of how a particular curriculum is positioned into an accreditation model. She concludes that "IS expects database students to achieve a higher level of learning (application) and IT expects database students to achieve the first level of learning (understanding)."

Sun (2003) and Kortsarts et al. (2009) discuss the technical and personal skills that need to be mastered in order to be an effective IT person. Necessary skills include: helpdesk skills, programming and optimizing code, systems administration, security, systems integration, database, web mastering, knowledge of disaster recovery procedures, and business planning. Such a person would also possess personal skills: creativity to know whether a thing is possible, ways to work around problems, organization skills, interpersonal skills, the ability to explain complexities in simple terms, to link components together, to see where future growth can happen, to work effectively on a team, and the spirit and practice of cooperation. The assessment of such skill mastery is, thus, critical to an IT program.

3. A CONCEPTUAL MODEL OF ASSESSMENT

Adapting the basic components of assessment from the ABET Assessment for Quality Assurance Model (ABET, 2010), we propose a conceptual model of assessment (see Figure 1),

which could be used to prepare educational assessment in general. The conceptual model consists of three parts: institutional/school/program level's guidance components, evaluation components, and feedback. The guidance components are related to the direction of institutional/school/program, which include mission, objectives, and outcomes. A mission is a broad and long-term vision of an institution/school/program. There will be objectives, outcomes, and strategies used to achieve the mission, but the mission is the eminent and most important aim to be accomplished. Objectives, on the other hand, are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Outcomes are statements that describe what students are expected to know and are able to do by the time of graduation (Vlasceanu, Grunberg, & Parlea, 2007). If students have achieved these outcomes, it is anticipated that they will be able to achieve the educational objectives after graduation. Appendix A shows an example of program level mission statement, educational objectives and outcomes. The evaluation components include performance measurement criteria of the guidance components, assessment of performance, and interpretation of the results of assessment. While the guidance components are about "where to go," the evaluation components are related to analysis mechanisms to answer "where do we stand."

Performance criteria are specific and measurable statements identifying the performance(s) required to meet outcomes (Prados, Peterson, & Lattuca, 2005).

These should be high level measurable statements that represent the knowledge, skills, attitudes or behavior students should be able to demonstrate by the time of graduation. Assessment is related to the processes that identify, collect, use and prepare data that can be used to directly or indirectly evaluate performance (i.e., achievement). Interpretation is the process that is used to interpret the meaning of the assessment results and provide recommendations. The feedback process is critical to creating and maintaining a systematic quality assurance system. When successfully implemented, all elements of the quality assurance process interact with one another (ABET, 2010). This model can easily be mapped to the assessment requirements of accreditation bodies such as ABET (2010), AACSB (2010), and SACS (2010), as well as the internal needs and framework for program improvement.

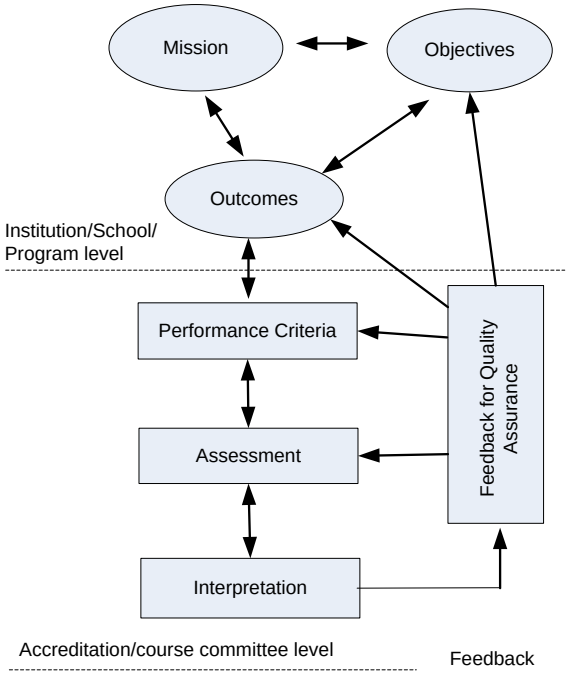

Figure 1: Conceptual Model of Assessment

4. ASSESSMENT MODEL IMPLEMENTATION

We followed this model to prepare for both ABET accreditation and internal program improvement. A committee of five dedicated faculty were selected for the assessment committee. This committee met regularly to spearhead the assessment cycle.

Assessment Methods: The assessment committee identified several methods in which assessment of outcomes could be done. Some of the methods identified were indirect methods of assessment, while others were direct methods (see Appendix B for example). Indirect methods were easy to implement and less time consuming. The best example of indirect methods is the exit survey. The results of these were not as convincing as they were more of an opinion rather than a fact. Nonetheless, they can be useful to effectively identify issues that need to be improved. Direct methods, on the other hand, were much more time consuming to the instructor; however these results were more relevant and accurate. The committee identified and adapted 11 as-

sessment methods, out of which 9 were direct methods of assessment.

It was critical that the faculty did not get overloaded with assessment. Overloading the faculty would have been a recipe for failure. It was imperative that assessment methods were assigned evenly. Therefore, some of the direct methods were identified to be prepared and judged by the course instructor, while others were assigned to be evaluated by a committee of faculty members or the course committees and still others were assigned to be assessed by industrial advisors.

Mapping Courses to Outcomes: It is necessary to find out which courses would satisfy the different outcomes for each program objective. The course committees for each class identified course goals for each course, and with these course goals, the assessment committee identified which courses mapped to which outcomes (see Appendix C).

Assessment Timeline: After learning outcomes and multiple assessment methods were decided, it was imperative that the assessment cycle was achievable, so that assessment did not fall through the cracks. It was the view of the committee that a good timeline that did not overly tax any one course or one person much would be a more practical assessment cycle.

The timeline took into consideration each objective for the program. Every outcome in each objective was assessed once every 3 years. In this way, most classes were assessed once every 3 years, or every 2 years at most. This seemed like a very achievable plan with very minimum impact on workload, which is a common concern among faculty (Hogan, Harrison, & Schulze, 2002).

Closing the Loop: Assessment on its own would have no impact on the program. The resultant recommendations and outcomes from the assessment would eventually make for a better program. As feedback mechanisms of quality assurance, the recommendations that are applied to the assessment results not only improve the program, but also give us information about the quality of classes, the quality and ability of our students, and shows us where we have to improve.

In closing the loop, we realized that some classes were overloaded with material. In some instances, it was necessary to add more material into classes, while some classes required no changes. Other categories of recommendations we had implemented include changes in program and course outcomes, changes in performance criteria and assessment tools, increases in course support and changes in instructors.

5. DISCUSSION AND LESSONS LEARNED

In this section, we present a discussion of our views and thoughts of the assessment. We also discuss the lessons learned in this work. These views, thoughts and lessons learned are summarized in the form of three best practices as follows.

Best Practices: Formation of a program accreditation and assessment committee
In the past, our ABET accreditation effort was spearheaded by one or two individual faculty members, usually the program chairs. This resulted in uneven faculty participation and missed tasks. Despite best efforts and successful accreditations, the experience was less than fulfilling for all those involved. There was not sufficient discussion among faculty members to recommend and implement comprehensive changes to improve the programs. Efforts were focused only on issues of perceived weaknesses related to accreditation. Furthermore, the concentration of work created stress for the lead persons.

However, it is also not realistic to manage accreditation preparation through the entire faculty body. We tried to discuss nuanced accreditation issues in the past which usually ended inefficiently as faculty with different levels of understanding tended to over discuss unimportant issues and details. The uneven level of contributions during and after the meetings also discouraged faculty participation.

In the latest ABET accreditation cycle, we formed a committee of five devoted faculty members to lead the effort for both accreditation and assessment. This turned out to be a suitable size for gathering ideas and actually executing the preparation plan. Every member was active. As the committee successfully resolved tasks effectively, a culture of teamwork established. The resulting collaboration continued beyond accreditation and assessment, resulting in resolving other program matters and publications of papers. Merging the accreditation and the broader assessment efforts also reinforced each other.

Best Practices: Adoption of a management process for accreditation and assessment

Accreditation and assessment involve many concurrent tasks to prepare a large collection of documents. These tasks need to be identified, refined and specified. Solutions to these tasks need to be designed and implemented (Mayes & Bennett, 2005). Leaders and supporters of tasks and deadlines need to be established and followed through. Many documents need to evolve in time and may also have variations to satisfy different needs. Furthermore, documents are updated and accessed by many different groups of users: faculty members, supporting staff, adjunct faculty, course committees, etc. Thus, in a sense, accreditation and assessment can be regarded as a project with many similarities with software development projects: risk management, version control, feature completeness, etc.

As a result, an early task our accreditation committee undertook was to adopt a reasonable project management process. On one hand, we needed a process to ensure the systematic identification and completion of needed tasks. On the other hand, the process needed to be informal enough to let innovative ideas flow freely.

As information systems and computer science faculty members, we borrowed ideas from Rational Unified Process (RUP) (Kruchten, 2003) and Scrum Development (Wikipedia, 2010). RUP is a leading iterative software development framework and Scrum is "an iterative, incremental framework for project management and agile software development" (Wikipedia, 2010). Ideas we borrowed from them are iterations of task management until completion, frequent and systematic status updates, change control, continuous quality verification, and heightened communications through frequent meetings.

The process we eventually adopted was to hold weekly meetings. All documents developed during the week were captured in a dedicated work area folder which also serves as an archive and version control. A progress file, simply in Microsoft Word format, documents every task, its leader and steps remaining to be done for the task. The urgency and progress status of each task is color coded. Each task was revisited each week to check its progress with possible re-examinations of their goals, design and implementations. This ensures that tasks are completed effectively within deadlines and that no task was missed. The longitudinal sequence of progress files also provides a good history of progress.

We were cautious to identify tasks that were best resolved during the meeting and they were worked upon immediately. For example, the assessment committee refined the wordings of updated program objectives during the meetings. This provided quick consensus so that the objectives could be presented to the full faculty body for approval rapidly. On the other hand, there were many tasks that could be accomplished individually after the meeting.

We would have used project management software which provides aids using a more formal project management process. However, since the key members met frequently in person, we found that our informal approach incurred the least overhead while keeping communications of ideas open.

Best Practices: Use of technology when appropriate

We used technology to aid the assessment process only when the benefit justified the overhead. We used an Intranet to provide easy access to the myriad of documents we created. There were sections to host documents that were relatively stable and areas for documents that were more volatile, requiring rapid changes. We developed a Web database application to hold the exit surveys of all undergraduate courses. The application also allows members of the course committees to enter their recommendations, which were then collected, discussed and approved. We did not use any particular collaborative tool for developing documents. Instead, the committee worked together to finalize versions created by individual members during our meetings. Using a real-time collaborative tool, such as *Google-Wave* (2010), is an experiment we will pursue in the future.

6. CONCLUSION AND FUTURE DIRECTIONS

In higher education institutions, the assessment process is a crucial task that can benefit many stakeholders. Assessment can be a very broad process with no fixed procedure or methodology mandated. In the information technology disciplines, however, there are certain rules and actions that are necessary to accomplish a reasonable assessment. In this paper, we presented a process model and some tools

for assessment for information technology programs.

The future direction in this work is twofold: (1) Unifying the terminology and language of the assessment. The definitions of the terms for assessment may lead to different notions in different contexts. Standardized assessment language and terminology will lead to simplifying operations that build upon assessment, like accreditation. (2) Relating model curriculums and accreditation requirements for specific disciplines with assessment models. This aids in using a holistic model to satisfy varying assessment goals. With the entire faculty participating in the assessment process, it was a very positive eye-opener for our program, and assessment was definitely a constructive addition to our program.

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APPENDIX A: Program Level Mission Statement (Example)

The mission of the undergraduate Computer Science program is to prepare students for productive careers in computing by providing an excellent and diverse environment for learning, research, and practice of computing theories, computer applications and software development.

Objectives and Outcomes
Objective #1: Computer Science graduates will be competent in the fundamentals of computer science.

- Outcome 1: Students can describe basic functions of computer hardware and software architecture.
- Outcome 2: Students will be able to effectively solve computing problems using an appropriate programming language, data structures and algorithms.
- Outcome 3: Students can design and analyze modern computer networks and data communications systems.

Objective #2: Computer Science graduates will be competent in core foundation of mathematics, the sciences and engineering related to Computer Science.

- Outcome 1: Students will be able to use basic mathematical and numerical methods to solve scientific problems.
- Outcome 2: Students will be able to solve fundamental probability and statistics problems.
- Outcome 3: Students will be able to apply discrete mathematics for solving problems in computer science.

APPENDIX B: General Assessment Tools (Example)

1. Examination Analysis [EA]: direct method
    a. Instructors map examination questions to specific performance indicators.
    b. Curriculum committee and instructors decide whether these indicators are satisfied or not.
    c. Curriculum committee and instructors make recommendations
    d. Curriculum committee reviews the assessment results and recommendations.

2. Assignment Analysis [AA]: direct method (including homework, programming and paper assignments)
    a. Instructors select assignments that map to specific performance indicators.
    b. Curriculum committees assess the assignment to decide whether these indicators are satisfied or not.
    c. Curriculum committees make recommendations.

3. Portfolio Analysis [PA]: direct method
    a. Every faculty member takes turn to serve in portfolio analysis.
    b. A selected group of faculty members assesses specific performance indicators by filling out an assessment rubric.
    c. The collected rubric assessment is used to decide whether these indicators are satisfied or not.
    d. The group of faculty members makes recommendations.

APPENDIX C: Mapping of Objectives, Outcomes and Performance Indicators to Course-Level Assessment (Example)

Objectives #1: Computer Science graduates will be competent in the fundamentals of computer science.
Outcome 1.1: Students can describe basic functions of computer hardware and software architecture.

Performance Indicators	Strategies	Assessment Methods	Source of Assessment	Time of data collection	Assessment Coordinator	Evaluation of Results
1.1.1 Understand the architecture of computer hardware	CENG3132 CENG3531 CSCI3331	AA or EA, ES	CENG3132	Fall	Instructor A	Department Curriculum Committee
1.1.2 Understand the major functions of operating systems	CSCI4534	AA or EA, ES	CSCI4534	Fall	Instructor A	Department Curriculum Committee
1.1.3 Understand fundamental relationship between hardware and software	CSCI3331 CSCI4534	AA or EA, ES	CSCI3331	Fall	Instructor B	Department Curriculum Committee
1.1.4 Design problem solutions using the PC assembly language.	CSCI3331	AA or EA, ES	CSCI3331	Fall	Instructor B	Department Curriculum Committee