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iAssess: Course Assessment Made Easy

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Abstract

Objectives: Introduce a methodology that can alleviate and automate course assessment required by accreditation bodies using handy tools such as spreadsheets. **Methods/Statistical Analysis**: To show the possibility of automating course assessment, we built a system, called iAssess, that consisted of a set of spreadsheets that provide templates for instructors to record student and course related data such as grades and course outcomes. Both student grades and course outcomes are programmatically linked such that whenever grades get updated, course outcomes get re-assessed seamlessly. **Findings**: To get a preliminary evaluation for the system, we tried it with 5 faculty members who dealt with almost 22 sections (approximately 400 students). The instructors were briefed about iAssess through informal sessions that lasted for 15 minutes each. Feedback was collected regularly every two months through informal interviews. Furthermore, after the adoption for two semesters, we conducted structured interviews in order to assess the attitude of instructors towards iAssess. Preliminary results showed that our system is easy to use, effective, and customizable. **Application/Improvements**: We envisage that our methodology and tool can be applied to any course assessment that is usually requested by accreditation bodies such as ABET.

Keywords: ABET Accreditation, Course Assessment, Spreadsheets

1. Introduction

The last few years have witnessed a growing awareness within the postsecondary educational institutions of the importance of assessing degree programs as a means of assuring high-quality education. Program assessment provides some insights for enhancing the overall curriculum (e.g. adding/removing courses or adjusting the sequence of their offering) or helps adopt a better pedagogy that may improve the learning process. Numerous academic instruments are used for assessing a program. Examples are course assessment, employer surveys, alumni surveys, academic advisory board and industry advisory board. This paper focuses on course assessment as an indispensable instrument that is widely used in colleges.

Essentially, course assessment is used to assess to which degree the Course Outcomes (COs) have been

achieved and the performance of these outcomes under the overall Program Outcomes (POs). Ideally and upon concluding a course, the majority of students should be able to perform according to the expected COs. The percentage of students who satisfactorily perform according to a particular CO provides an indication of how much the course is successful at fulfilling that outcome. This percentage provides a feedback to course instructors so that they can take corrective actions if necessary². For example, based on the results of the course assessment, the instructor may modify the syllabus, change the way the material is delivered, select an alternative textbook or recommend other tools to assess the COs.

In addition to the feedback given to instructors, course assessment ideally maps each CO to POs. This mapping determines how much each of CO contributes to each PO. As a result, the findings spawned from the course

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assessment can be used as a vital feedback to the administration of the teaching institution to determine which courses need extra attention or if there is a need to offer additional courses that can fulfill the POs. The assessment can be also an invitation to review both COs and POs and their mutual associations.

ABET (Accreditation Board for Engineering and Technology) is an accreditation organization for postsecondary degree programs in applied science, computing, engineering and technology³. Its main goal, like other accreditation organizations, is to ensure that the education provided by the teaching institution meets predefined levels of quality by following a specific assessment process. Because of the valuable feedback it provides, course assessment plays a major role in the ABET accreditation.

Regrettably, course assessment is one of the most cumbersome ongoing duties that a faculty has to do throughout the semester. It involves planning, preparation, organization, procedures and instruments. Based on our experience and being aware of what other colleagues do in similar institutions seeking accreditation, course assessment is laborious and can easily consume a big deal of academicians' time.

When it comes to administration, course assessment poses three challenges. First, ABET, like other accreditation organizations, merely provides guidelines for how to do assessment. This can be considered as an advantage in the sense that each educational institute can tailor the implementation to suit its circumstances. However, experience has shown that this also can be a source of problem as there is no clear implementation model to adopt. The second challenge is the difficulty of managing the process especially that the assessments conducted at lower levels, such as course assessments, should propagate to the higher levels of assessing the overall POs. Third, officials typically find it a big burden to maintain, organize and analyze massive amount of assessment data that are scattered among data stored in computers, archived in drawers and filed into cabinets.

From the above discussion, there is a real need for automating course assessment in a way that is easy to use, customizable and affordable. In this paper, we present a model and implementation of a system, which we call iAssess, that automates the assessment process within the context of ABET accreditation. An important feature of iAssess is that it shifts the focus and the perception of educators from the mere gathering and piling of assessment data to the process of analyzing and gleaning useful

information that helps improving the educational ambiance for students. iAssess is basically a set of spreadsheets that provide templates in which instructors can fill basic academic data such as the mapping of the COs to POs, the relationship between the various class activities and the COs and the student grades for each activity. Using these raw data, iAssess produces a set of reports that indicate how well students performed for each course outcome and what is the impact of the course on the program outcomes in general.

The rest of this paper is organized as follows. Section 2 presents some related work. Section 3 introduces an overview of iAssess. The assessment metric is discussed in Section 4. iAssess modules are explained in Section 5. A preliminary evaluation for the iAssess tool is described in Section 6 and Section 7 concludes the article.

2. Background

Many systems have been developed for course assessment. Examples are Course Assessment Plan⁴, Web Submit^{5,6} and the web-based course assessment system⁷. In the Course Assessment Plan⁴, the authors emphasize the importance of linking program curriculum management to course assessment. The authors in^{5,6} proposed a database template to perform course assessment based on selected student work metadata. They also developed a prototype, called WebSubmit, which allows students to submit their work for assessment over the web. WebSubmit can then extract the assessment metadata from the submitted work to perform course assessment.

In another work², Poger et al. presented a web-based electronic course assessment system. The system is developed by students and uses database for gathering assessment data. Upon entering assessment data by instructors, the system can generate various reports about students' performance. This system, however, uses proprietary software that may limit its adoption in other universities.

Many commercial course assessment systems exist. Examples of these systems include WEAVEonline⁸, Blackboard Learn for Outcomes Assessment² and Measurement and Assessment Tools from Desire2Learn¹⁰. On the one hand, commercial systems such as Blackboard Learn for Outcomes Assessment² and Measurement and Assessment Tools from Desire2Learn¹⁰ are Class Management Systems (CMSs) that are utilized to include course assessment data. On the other hand, WEAVE

online is a web-based system dedicated for course assessment⁸. Like other CMSs, the license fees for these systems can be a financial burden on academic institutions.

3. Overview of iAssess

iAssess is a set of spreadsheets that provide templates for instructors to record student and course related data. The adoption of iAssess starts from day one of the semester where the instructor feeds in the student roster. iAssess implements an assessment process whose flow is depicted in Figure 1. The process goes through the following stages:

3.1 Adopting Previous Recommendations

Initially and before deciding on the course material, activities, schedules, etc. the course instructor should review recommendations produced by the last run for the course. This is an indispensable step as it closes the course assessment loop.

3.2 Initialization

At this step, the instructor feeds iAssess with the student roster. Furthermore, the instructor inputs some basic information about the course, outlines COs and POs and maps them to each other with specific weights.

3.3 Course Activities

A course activity is any task assigned to students during the course such as a quiz, homework, project or lab experiment. Each activity is represented by a separate spreadsheet. An activity consists of a set of elements. An element can be a question in an exam or a presentation component of a term paper. Within the activity spreadsheet, the instructor can map each element to a CO. In the same spreadsheet, the instructor records the student attained grades of that activity. Transparently, iAssess assesses the performance of each student and the performance of the entire class and provides interim as well as final course assessment reports. The interim report is useful as an on-going feedback for the instructor to spot weaknesses and take necessary corrective actions on time.

3.4 Reviewing Course Assessment Report

By the end of the course, the overall course assessment report is generated. The instructor can use this report to analyze the results and recommend corrective actions to close the loop.

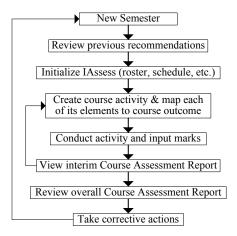


Figure 1. The assessment process in iAssess.

4. Assessment Metric

In general, ABET does not impose any specific quantitative metric for assessing students' performance. Initially, we used the arithmetic mean as the main metric. However, its sensitivity towards class size and tendency to be centered on some common value (such as the 70%) were observed. Moreover, we frequently faced questions such as "what is the minimum grade that is achieved by 60% of the students". This led us to adopt the percentile notation, in which the percentile is the value of a variable below which a certain percent of observations fall. For example, the 20th percentile is the value (or score) below which 20% of the observations may be found. Therefore, if we are interested to know the minimum grade achieved by p% of the students then we should compute the percentile of (1-p). For our purpose and since we are interested in the minimum level achieved by 70% of students, we compute the 30th percentile.

5. iAssess Modules

iAssess is a set of five modules represented by spreadsheets (Figure 3), which we briefly describe next:

5.1 Dashboard Module

It is a summary sheet that gives the instructor an overall view of the class (Figure 4). It has basic information about the course such as the instructor's name, the course's title, the top two outcomes that this course has impact on, the percentile value that is used as a key threshold in the assessment process and the grade of each student. The dashboard provides also a view of the evaluation activities and their weight distribution as well as hyperlinks to each activity spreadsheet.

5.2 Course Settings

The course settings list all COs and POs and reiterates the POs to be assessed and the percentile used (Figure 5). The main objective is to provide the contribution of each COs to the POs. The mapping of a CO to a PO can be weak, medium, or strong.

5.3 Activity Pool

Seeking a robust design that helps make iAssess easy to adopt, we represent an evaluation tool (such as quiz, project, etc.) as an abstract Activity. An Activity has a flexible structure to accommodate various student activities from an atomic activity like a single-question pop up quiz to a compound activity such as a term project that consists of several sub-graded elements like simulation, experiment, presentation, report, etc. (Figure 6). Each Activity is represented by a separate spreadsheet that contains information about that activity. The instructor enters the grades out of 100 and the spreadsheet automatically re-scales the grade based on optional weights specified by the instructor.

5.4 Calculations Module

The calculation module is responsible for crunching numbers in order to come up with quantitative measures for the course assessment. It carries out its job transparently from the users. Other iAssess spreadsheets feed the calculation module with different kinds of data needed to do the computations, such as student grades in the various class activities (homework, quizzes, midterm and final exams, etc.), the mapping of the COs to the POs and the mapping of the activities to the COs. The calculation module produces two significant outcomes: The achievement of the course under each CO and the achievement of the course under each PO (Figure 2).

To give a glimpse of these calculations, the partial performance of the student under a course outcome in a specific activity is computed as follows:

$$Performance_{c,a}^{s} = Weight_{a} \times \frac{\sum_{e=1}^{ne} \left(\frac{Grade_{s,e}^{a}}{GradeMax_{e}^{a}}.M_{e,a}^{c} \right)}{\sum_{e=1}^{ne} M_{e,a}^{c}}$$

Where,

 $\begin{aligned} & \textit{Performance}_{c,a}^s = \text{Weighted Performance of student sunder CO } c \text{ in activity } a \\ & M_{e,a}^c = \text{Mapping of Element } e \text{ in activity } a \text{ to course outcome } c \\ & \textit{Grade}_{s,e}^a = \text{Grade earned by the student sin element } e \text{ of activity } a \\ & \textit{GradeMax}_e^a = \text{Maximum Grade of element } e \text{ of activity } a \\ & \textit{Weight}_a = \text{Weight of activity } a \end{aligned}$

ne = Number of Elements

5.5 The Report Generator Module

iAssess does not merely collect data but it presents analyzed information (Figure 7). It generates a detailed assessment report where it shows, for each CO and PO, the percentage of students who achieved at least 70% of the total course grade (i.e. the 30th percentile of the grade). From our experience, this quantitative assessment has been the most laborious part of the assessment report in the past. iAssess takes care of this part transparently. On top of the quantitative assessment, the report allows course instructors to freely express their opinions and document their findings by writing textual notes under each CO and PO.

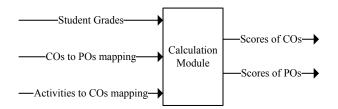


Figure 2. Calculation module block diagram.

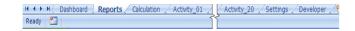


Figure 3. The spreadsheets of iAssess.

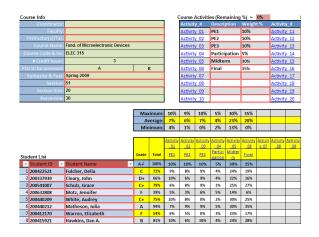


Figure 4. A snapshot of the dashboard sheet (Student IDs and names are hypothetical).

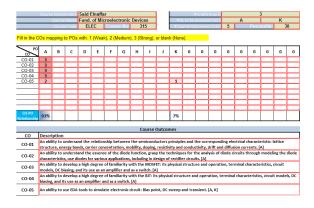


Figure 5. A snapshot of iAssess settings.

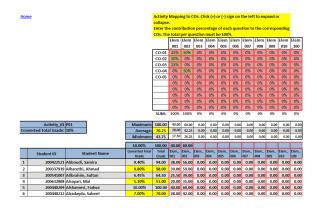


Figure 6. A snapshot of activity mapping (ID and names of students are modified). A course activity could be an exam question, homework, a quiz, etc.

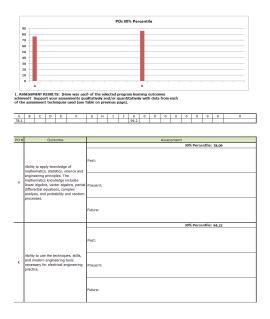


Figure 7. The report lists the top two POs that this course has significant impact on and outlines the performance of students in each PO.

6. Preliminary Evaluation

Our tool has been in practice for at least two years. Due to the space limit, we report some glimpses of its evaluation. However, we are presently conducting a full scale of evaluation that includes more than 20 faculty members as participants from several schools.

Here, we report the preliminary evaluation results gleaned from the experience of 5 faculty members with the tool who had the first exposure to iAssess as a pilot project. This gave the chance to use the tool with almost 22 sections (approximately 400 students). To get them started, the instructors were briefed about iAssess through informal sessions that lasted for 15 minutes each.

Feedback was collected regularly every two months through informal interviews. Furthermore, after the adoption for semesters, we conducted structured interviews in order to assess the attitude of instructors towards the iAssess tool with respect to its ease-of-use, effectiveness and customizability. We summarize our findings as follows:

6.1 Ease-of-Use

Throughout the short briefing sessions, we felt that the participating instructors are finding iAssess intuitive especially it is implemented using Excel. On average, we got 3 to 5 clarification questions in the first month of deployment. A few quotes from our participants:

"The tool is simple and friendly. The briefing session is indispensable and I suggest having it as a video tutorial", participant #5.

"iAssess is easy, no installation neede, and its learning curve is smooth", participant #2.

6.2 Effectiveness

All participating instructors hailed the tool as an assessment helper. Collectively, instructors appreciated the ability of being able to observe the performance of their students throughout the semester. They do not have to wait until the end of the semester to get the performance figures for each outcome. Rather, course outcomes are updated instantly whenever new set of grades are recorded. Quotes from our participants:

"It is nice to have a tool that takes care of the dirty work of assessment computation", participant #4.

"I typically do the assessment of my sections at the end of the semester, but with iAssess I found that the assessment of the outcomes is effortlessly done with each single grade I enter into the system", participant #3.

6.3 Customizability

iAssess is designed to accommodate the various needs of instructors with respect to their grading scheme (assignments, projects, labs, etc.) and course outcomes mappings. The instructor needs to configure iAssess only once at the beginning of the semester to suit his syllabus and grading scheme. In general, participating instructors reported that iAssess shows high degree of flexibility and resilience towards their needs. However, instructors stressed on the idea of having a video tutorial beside the tool as a reference. A few quotes are:

"The tool was able to accommodate the needs of my course and the design of the grading policy I have", participant #2.

"After trying iAssess, I trust that any instructor will be able to configure it the way it suits his or her course – the tool is flexible enough", participant #4.

Overall, we have not encountered the case in which the instructor pushed iAssess to its limits of customization, i.e. most of them had a classical grading system and outcomes mapping that iAssess can handle seamlessly.

7. Conclusion and Future Work

In this paper, we introduced iAssess, a spreadsheet-based system that automates course assessment. The paper presented a detailed discussion of the different iAssess modules. iAssess exemplifies how to build a tool that assesses any course and its performance under the program outcomes. In addition to automating the assessment process, iAssess standardizes the process within the institution and among faculty. The main advantage of iAssess is that it shifts the focus of the course instructor from gathering assessment data to analyzing the assessment information reports generated by the system and deciding on the corrective actions if needed to help improve the overall educational process.

The reported preliminary evaluation for iAssess is very encouraging as participating instructors expressed

their appreciation of having such a tool around for assisting them with the laborious course assessment process. We are presently conducting a bigger scale of evaluation that includes a larger number of instructors from different discipline, and distributed geographically. The data will be collected via structured interviews and questionnaires. To facilitate such evaluation, we will produce a self-briefing package for instructors that will include a video tutorial, as recommended by our participants in the preliminary evaluation phase.

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