Establishing Baseline Goals and Objectives for the Development of Educational Outcomes Using an Online Instrument

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Introduction

A primary effect of the ABET TC2K accreditation requirements[1] is to cause programs to organize and make explicit that which has usually been done implicitly. For example, many programs have existing objectives and outcomes with which they operate, although they are often unstated or relegated to the course level with little attempt to coordinate them systemically. Prior to the creation of outcomes and objectives to satisfy ABET criteria, it is important to establish a reliable baseline of this current state, a snapshot of the existing curricular and instructional activity. Taking the time to do this will accomplish three important goals:

1. The faculty will become familiar with the terms to be used in the development of ABET outcomes and objectives while working in the comfort of their existing courses.
2. The faculty will identify areas of weakness in existing educational practices and assessment processes.
3. ABET design groups will be able to locate existing measurement points for collecting embedded data related to outcomes.

Penn State Altoona is currently testing an online system designed to collect data on existing practices in an unobtrusive and consistent manner. Each week, faculty are asked to log on the system and enter their goals and objectives for the past week, along with a short synopsis of their effectiveness in achieving them. This information is stored locally and can be accessed in order to develop a list of objectives currently being pursued by each faculty member. Collecting this information as near as possible to its presentation to students controls for gaps in memory that are sure to come up in any post-semester meeting on course objectives. This activity is useful on several levels. The faculty benefit from the weekly reflection on each class, something that is all too often seen as a luxury. The data thus obtained can be used by an ABET group to map the objectives against ABET outcomes, check for redundancy, and identify omissions. This provides an excellent starting point for outcome and objective definition as well as an indicator for embedded assessment opportunities.

This paper will report on the current state of the online data collection process and faculty response to this system.

Background

In previous years, program accreditation consisted primarily of simple measurements: How many credits of math were required, what laboratory space was available, the qualifications of the faculty, etc. Recent changes introduced by ABET have shifted the focus considerably in that programs now must identify and measure student outcomes and provide a feedback cycle to continuously improve the educational program.[1] To be effective, evidence of attainment should be collected from faculty, students, and industry partners. Multiple collection points allow findings to be compared and compiled in order to give the most complete picture possible. Most practitioners agree that this is the end goal for any program assessment system. A question that must be answered, however, is where to start? Penn State Altoona decided to begin with some good baseline measurements. It is important in any large-scale change effort to include as many of the ultimate stakeholders as possible in the design of the change. Rather than set up representative committees made up of faculty members, we went directly to each faculty member for his or her input via the World Wide Web.

Instrument Design

Primary considerations during the design of the data collection instrument were that it be easy for faculty to use and that it provide something of value beyond ABET data collection. To this end, the interface was designed to provide a quick visual summary of completed and required items. Specifically, items were colored green if they were completed, yellow if they were due, and red if they were overdue. Faculty were requested to make weekly entries during the semester. After a logon page, faculty are shown a list of their current courses (Figure 1.).

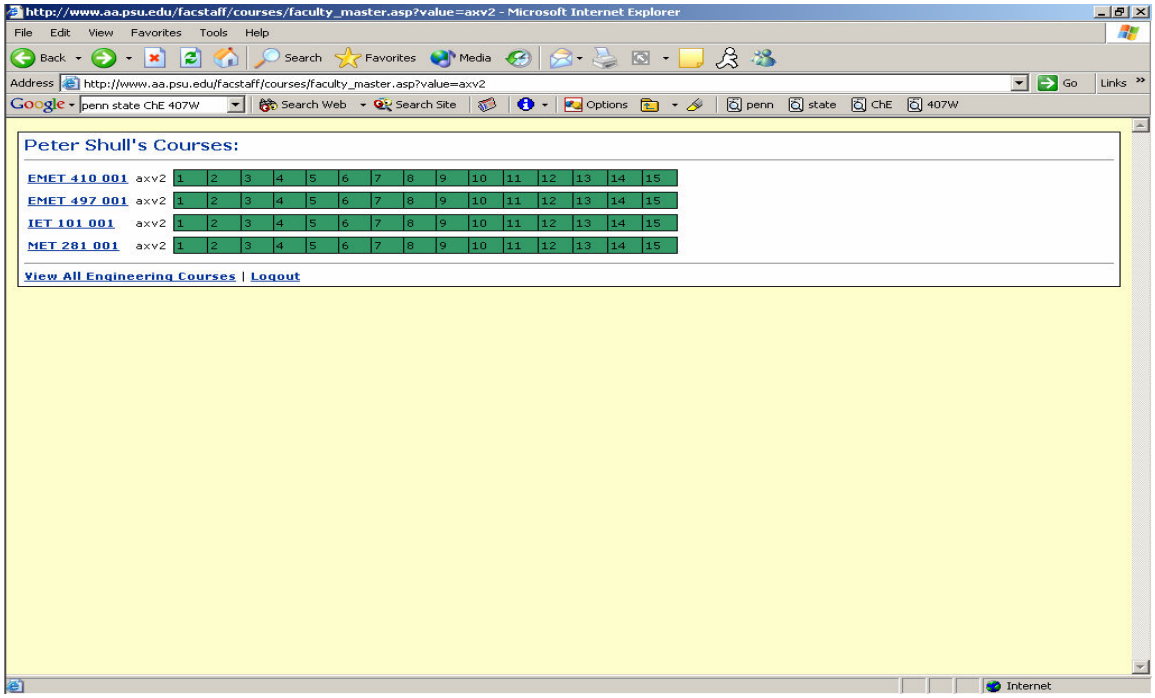

Figure 1. Sample List of Courses

From this page, faculty can easily determine if any entries are due or past due. Clicking on the course title takes the user into that particular course (Figure 2.).

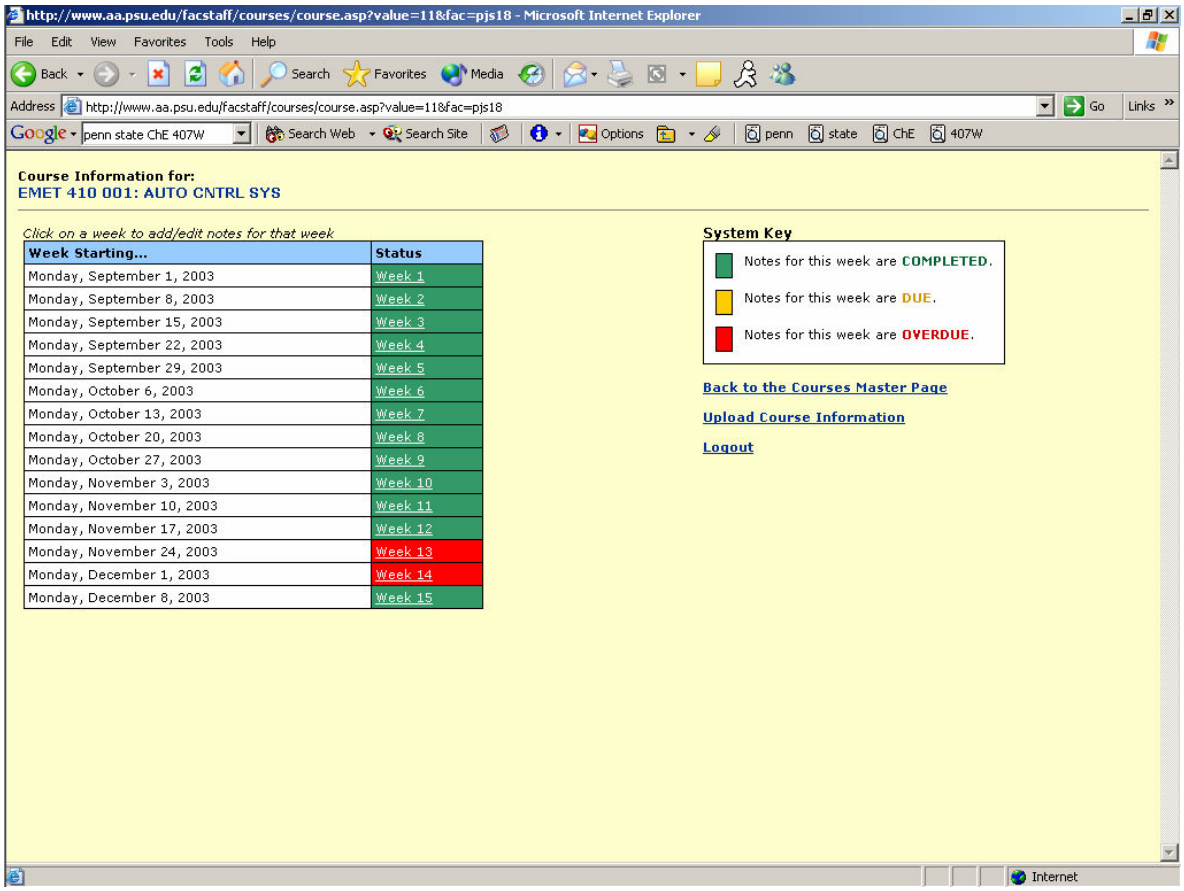

Figure 2. Sample Course Data Page

In order to check a previous week's entry or to make a new entry, the faculty simply click on that particular week. If data is to be entered, the window displays three text areas. The faculty member is asked to list the primary learning goals for the week, the learning objectives, and a summary of his or her efforts ("How did it go?"). This page is represented by Figure 3. For the first iteration, no examples or further instructions were provided via the instrument. This openness provided the opportunity for the faculty to think about their courses with few constraints. It was thought that the quality of the entries thus obtained could be used to assess both faculty understanding and the possible need for further training in addition to the basic data collection.

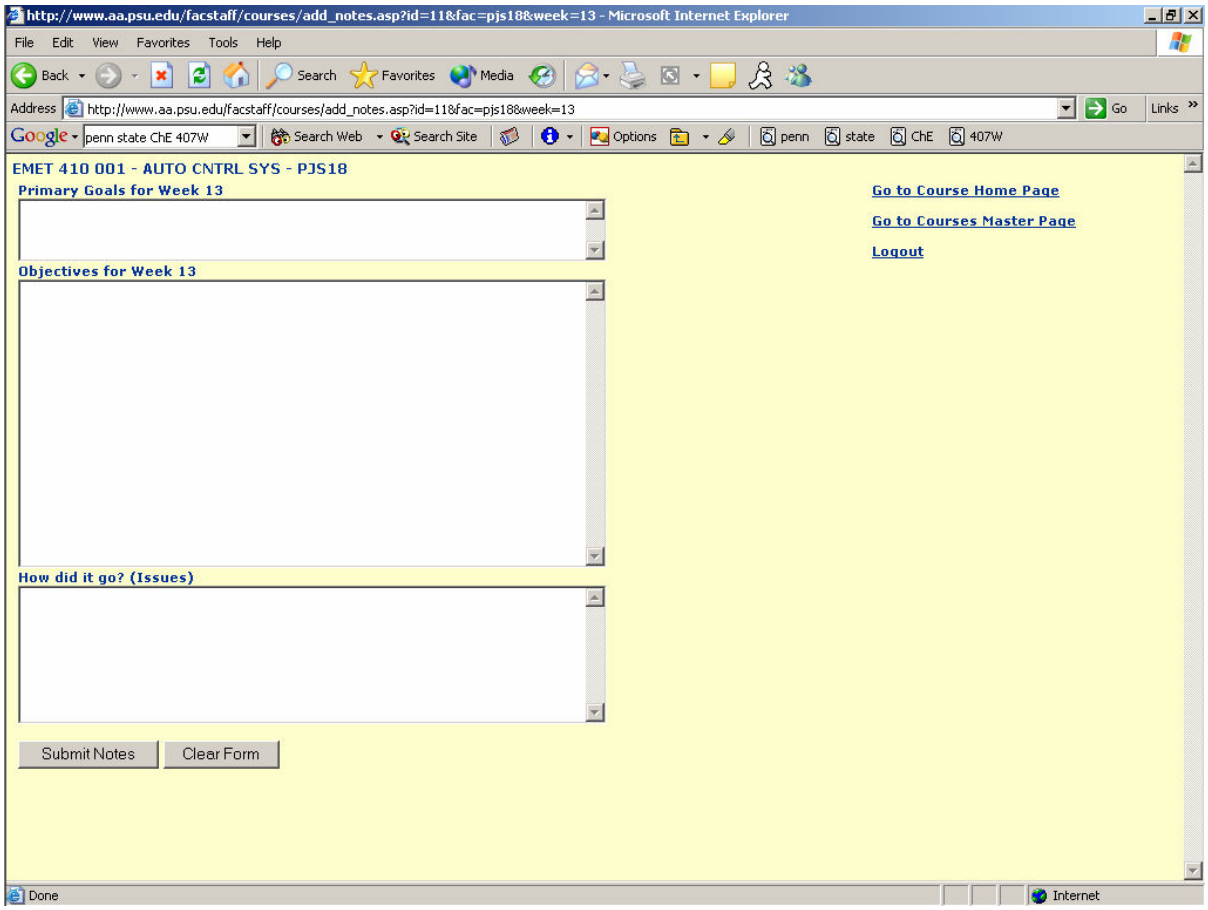

Figure 3. Data Entry Page

Once the data has been submitted, any faculty member may review what has been written, as displayed in Figure 4. Ideally, this instrument will provide a summary of the learning goals and objectives for each course within the program on a weekly basis as well as a short report from the faculty as to their success along with potentially useful advice for the next time the course is presented. In its current form, the instrument only restricts data entry to the course instructor. Any instructor can view any other instructor's entries. This openness is intended to facilitate understanding of the entire curriculum, as each instructor has the opportunity to see the weekly topics, goals, and objectives for each pre-requisite, concurrent, and subsequent course. The instrument was tested for functionality and placed in service at the beginning of the Fall, 2003 semester.

Faculty Preparation

Prior to the start of the semester, a training session was held for interested faculty. This training session focused on instructional design issues, particularly the development of Learning Goals and Learning Objectives. The instrument itself was secondary to an understanding of the design principles on which it was based. The terminology was taken from the education literature in order to have the maximum applicability.[3,4,5] Faculty were asked to consider both goals and objectives from a student point of view. Goals are expected to be broad statements related to the

purpose(s) of each course. As broad statements, goals are not usually measurable in themselves. Objectives are written to support the goals, and are much more specific and therefore measurable. Objectives were to include four components: *Audience* (the expected learner, may be implied), *Behavior* (what the student will be asked to do to demonstrate knowledge or understanding), *Condition* (what the student will be given – calculator or paper and pencil, for example), and *Degree* (how well the student must perform to meet the objective). This model was chosen because the "ABCD" mnemonic is easy for faculty to work with and results in a measurable objective.

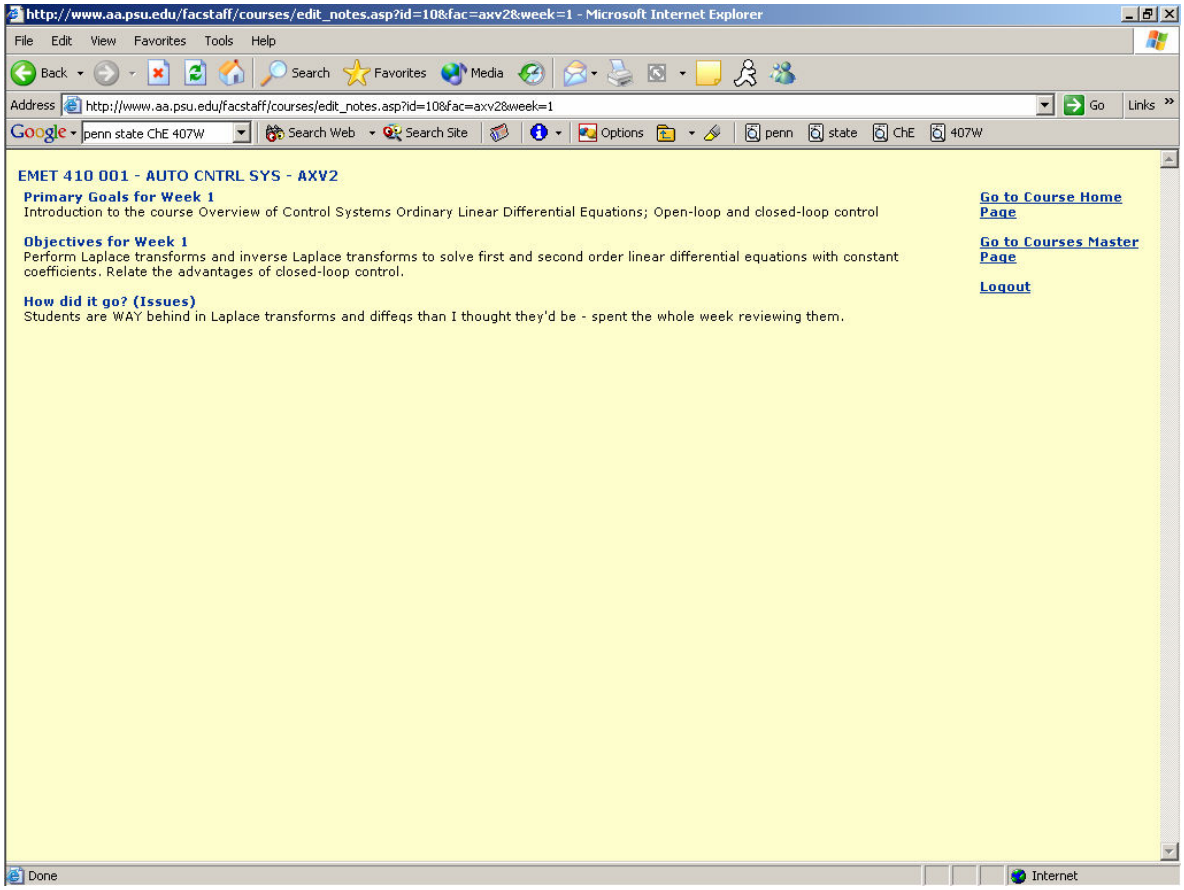

Figure 4. Sample Data Review Page

Initial Results

Faculty participation was high in the first semester. With ten teaching faculty and twenty-seven offered courses, over 75% of the possible weekly entries were completed. The percentage was even higher when one considers the fact that faculty teaching more than one course were only asked to enter data for one of their courses. In a post-semester meeting, the general feedback from the faculty was positive. Most felt that the experience had helped them to understand their individual courses better and to begin to see how their courses fit into the larger program. Several of the faculty took advantage of the opportunity to see what their peers were doing. None expressed concern for this data sharing. The single administrator present at the meeting expressed satisfaction with the instrument and the ability to review the current status of all of the active courses in the curriculum. Some faculty who were also involved in ABET committees

expressed concern that efforts were being duplicated, as these groups are also mapping outcomes to courses. It was emphasized that the data collected directly from course instructors using this instrument is supplemental to the work of ABET curricular committees, reflecting an accurate view of the current state of the curriculum as it exists in actual practice. Changes that incorporate this data from the instructors are more likely to be institutionalized than any top-down directives, no matter how well-designed.[6] The faculty decided to continue to use the instrument in the Spring semester.

The quality of the entries varied as expected. From a faculty development perspective, this was an excellent way to judge the effectiveness of the pre-semester training in the development of learning goals and objectives. It was obvious that not all of the faculty understood the shift being made from teacher-centered to learner-centered goals and objectives. Some of the entries reflected teaching strategies rather than goals and objectives:

> **Primary Goals for Week 5**
> Introduce students to Stress Analysis Project Proposal. Teach students to apply strain gauges to aluminum tensile specimens.
>
> **Objectives for Week 5**
> Explain to the students the requirements and purpose of the Stress Analysis Project. Assign a one page Stress Analysis Project Proposal that explains the item on which they would like to perform a simple stress analysis. Due date is the next class period. Explain the operation of strain gauges and how to apply them to specimens. The students were asked to apply the strain gauges to aluminum specimens.

These goals and objectives are obviously related more to the instructor's activity rather than to what the student will be able to do to demonstrate their understanding. This type of entry, however, is excellent source material for development and assessment professionals to use when consulting with the faculty on improving their course goals and objectives. As training is provided, these entries will improve. Thus, this instrument will provide longitudinal data demonstrating the results of faculty training. These results may be incorporated into the ABET continuous improvement process, as well.

> **Primary Goals for Week 2**
> Modeling; electrical components Mechanical, electromechanical and thermal components
>
> **Objectives for Week 2**
> Specify an op-amp circuit to create a given transfer function. Specify electrical analogues of mechanical and electromechanical devices including masses, springs, dampers, transformers, solenoids and potentiometers. Perform mesh and node analyses of electrical circuits and write resulting differential equations.

This example is more in keeping with a student-centered focus. The goals are listed as topics rather than as a set of statements, but the meanings are generally clear. The objectives refer to

student activity and give some indication of the conditions under which the students will be required to perform ("given transfer function"). These two examples can be contrasted in subsequent training to help faculty see the difference between goal/objective orientations.

The "How did it go?" section was interpreted in different ways by different users. Some saw it as relating to assessment of the objectives, while others thought it was meant for teacher reflection. The initial design intentionally left this open in order to allow faculty freedom of expression.

> **How did it go? (Issues)**
> Students too unfamiliar with mesh and node analysis - review needed. Book is a disaster - lots of mistakes in solutions manual, text. Need to give students copies of slides, not let them print them out. AV problems in room, half of one class lost.

> **How did it go? (Issues)**
> Students are WAY behind in Laplace transforms and diffeqs than I thought they'd be - spent the whole week reviewing them.

> **How did it go? (Issues)**
> I was able to meet all my objectives.

Overall, the instrument functioned as expected. Faculty had little difficulty in logging on and making entries. While the format and content varied somewhat between users, the differences are not insurmountable and provide direction for subsequent faculty development.

Next Steps

The data collected to date will be analyzed in depth over the coming months. Goals and objectives obtained via this instrument will be re-worded to conform to accepted forms. These re-worked goals and objectives will then be built in to subsequent versions of the instrument, allowing users to select the appropriate goal or objective from a drop-down menu rather than having to re-type them each week. The instrument will be further modified based on user feedback and data collection continued through the Spring semester. Specifically, pop-up definitions and examples of good goals and objectives will be provided for reference in order to move towards greater standardization of form. Faculty will be given the option of making entries weekly or based on class periods. Output will be improved, to allow for a complete listing of all goals and objectives so that they can be mapped within the curriculum and connected to ABET requirements where appropriate. A major advantage of this system that is yet to be realized is that we are likely to identify current measurement points that will be appropriate for ABET-style reporting. This will reduce the need to create new instruments or processes for ABET, as we will be able to extract evidence from current practice ("embedded assessment").

There was some difficulty due to ABET terminology not lining up with the terms used with the instrument. For example, "Learning Goals" relate to ABET "Objectives", while "Learning Objectives" are most like the ABET "Outcomes". It is regrettable that this was not anticipated

during the design stages. Some translation will need to be made, either as a straightforward modification of the instrument or through additional training.

Conclusion

Referring to the three goals mentioned at the beginning of this paper, it appears that faculty are becoming familiar with the terms used in outcome-based learning. Building the faculty's knowledge of outcome-based educational goals and outcomes is an important first step in moving towards the adoption of an ABET-style continuous improvement system.[7] Spontaneous discussion of student abilities in pre-requisite and subsequent courses occurred during the follow-up meeting, indicating that faculty are beginning to think in terms of outcomes. Through this discussion, they began to identify weak areas in the overall program and discuss how they can be addressed (goal 2). The third goal, ABET design groups making use of this collected data, has yet to be observed. Faculty awareness and involvement at this early stage will improve their understanding of the upcoming ABET review and should result in greater buy-in for any needed changes.[6]

Good program assessment requires quality data from multiple sources. The first step in assessment is to determine the baseline in order that the effect of any future changes can be demonstrated. This paper reports on an online instrument designed to gather baseline data on course content and delivery from front-line faculty members on a regular basis while courses are in session. The data gathered include learning goals, learning objectives, and a review of the experience. When compiled, this data will give administrators and ABET committee members an accurate picture of the current state of their curriculum. ABET outcomes can be more accurately mapped to courses based on current practice rather than theory. Required assessment points can be identified as they exist and incorporated into ABET data collection without needing to design or implement a separate assessment tool or process. Embedded assessment is much more likely to be continued beyond the ABET review period.

The instrument also provides a place for faculty members to organize their course goals and objectives and to reflect on their success after every period. This data is then available to any subsequent course instructor, much as a course journal would be. This can be a very effective way to help faculty regularly consider what they are doing and how it fits into the larger curriculum.

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