WEAVEonline: An Assessment and Planning Management System for Improving Student Learning

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Abstract

Every degree-granting program at Texas A&M University is required to participate in the assessment of student learning outcomes using WEAVEonline system. The assessment data is then used to identify improvement opportunities.

WEAVEonline is a management system for program assessment and planning. Specific student learning outcomes are identified or revised at the beginning of each year. Numerical target values are set. Multiple assessment methods are selected to evaluate the extent to which these outcomes are achieved. Assessment data are collected, analyzed, and uploaded to the WEAVEonline system. Each program is required to use the data to show whether specific student learning outcomes targets are met. Weaknesses are analyzed and corrective action plans are recommended by each program.

This paper discusses the experience that the Electronic Systems Engineering Technology program gained through the WEAVEonline assessment process. Topics of discussion include statistical analysis of the assessment data, trend analysis, and documentation.

Keywords

Assessment, student learning outcomes, WEAVEonline

Introduction

While the most important assessment and improvement for student learning may be the ABET accreditation process that happens once in every six years, many higher educational institutions also go through other accreditation processes.

Texas A&M University is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), one of the eight accrediting bodies in USA. The SACSCOC accreditation is a tool to ensure student learning and oftentimes a requirement for receiving federal funding. Typically, institutions of higher education are reaffirmed of the SACSCOC accreditation every ten years. A year before the reaffirmation, a compliance certification is submitted to SACSCOC. This document is reviewed by an off-site team of peer institutions of higher education. The results of the review will be sent back to the university to address shortcomings identified by the review team. An on-site review team of peers will do a campus visit. A fifth year interim report is also required between the reaffirmations. SACSCOC requires that a Quality Enhancement Plan (QEP) is in place for continuous improvement.

There are many similar software packages that can be used for academic program assessment and planning. These include eLumen[2], Taskstream[7], Tk20[8], and True Outcomes[9]. Oakleaf[3] analyzed the pros and cons for these software packages. RiCharde did an extensive review for these and many other data management tools[6]. Some universities use software developed by themselves[5]. Texas A&M University chose to use WEAVEonline[10] for each program to submit a report every year.

WEAVEonline is a management system for program assessment and planning[4]. The continuous improvement process for student learning is illustrated in Fig. 1.

Figure 1. The WEAVE process

In the first step (Write), specific student learning outcomes are identified or revised at the beginning of each cycle, typically one year. Numerical target values are set. Multiple assessment methods are selected to evaluate the extent to which these outcomes are achieved. The second step (Establish) is the delivery of academic programs. The third step (Assess) is the collection of assessment data. The fourth step (View) is analyzing the assessment data. Each program is required to use the data to show whether specific student learning outcomes targets are met. Weaknesses are analyzed and corrective action plans are recommended by each program. In the fifth step (Effect), action plans are created for the next cycle. All the assessment data, analysis, and action plans are uploaded to the WEAVEonline system. The reports are evaluated by the Assessment Review Executive Committee, which is comprised of representatives from various colleges and divisions from across the institution, submits an annual State of Assessment report to the provost commenting on the overall status of assessment quality, the defined next-steps for improvement, and the overall assessment review process.

Mission, goals, learning outcomes, and targets

The first step in using the WEAVEoline system is to create the mission statement followed by goals, student learning outcomes. The mission statement is reviewed periodically. Any revision

would be updated in the WEAVEonline system. The mission statement for ESET is given as follows. This statement is posted on the ESET website and used in ABET accreditation.

Mission / Purpose

The Electronic Systems Engineering Technology (ESET) program prepares graduates for immediate impact and long-term career success by providing a real-world experiential education coupled with personalized undergraduate experiences in electronics product development, test, system integration, and engineering research.

The goals are more specific than the mission statement and are chosen to ensure the mission statement can be achieved. The ESET goals, four in total, are listed as follows.

Goals

G0: Immediately Productive in the Workforce

The Electronic Systems Engineering Technology Program at Texas A&M has as a primary educational objective to produce graduates who possess the technical skills to be immediately productive and have successful careers in regional, state or national electronic product and system development industries.

G1: Demonstration of Leadership and Responsibility

The Electronic Systems Engineering Technology Program at Texas A&M has as a primary educational objective to produce graduates who demonstrate increasing levels of leadership and responsibility during their careers.

G2: Commitment to Ethics and Social Awareness

The Electronic Systems Engineering Technology Program at Texas A&M has as a primary educational objective to produce graduates who exhibit a commitment to professional ethics in their professional career.

G3: Desire for Life Long Learning

The Electronic Systems Engineering Technology Program at Texas A&M has as a primary educational objective to produce graduates who display a desire for life-long learning through continued education, technical training, and/or professional development.

Student Learning Outcomes with Related Measures, Targets

To achieve the goals, one needs more specific and measurable student learning outcomes (SLOs) as objectives. ESET chose five of the Program Educational Objectives (PEOs 1, 4, 5, 7, 9) from ABET accreditation as the SLOs. SLOs must be meaningful and measurable. They may involve knowledge, skills, attitudes, and development attributes, and typically start with an action verb that is measurable. ESET chose to use the verb *possess*. Other examples include: create, design, assemble, evaluate, identify, explain, describe, employ, and demonstrate. One should try to

avoid verbs that are vague and not easy to measure, such as understand, be familiar with, appreciate, value, and embrace. When developing the SLOs, the focus should be on the end result, not the means.

Three different types of measures are used by ESET for assessment of the LSOs: Capstone evaluation by the Industrial Advisory Committee (M1), course objective assessment by faculty members (M2), and Senior Exit Survey (M3). Detailed descriptions of these three assessment methods are omitted here. Specific targets are defined for each measure by inspection of the data across multiple years of data collection.

SLO 0: Knowledge of Tools and Skills

The students graduating from the Electronic Systems Engineering Technology program will *possess* an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.

SLO1: Application of Design

The students graduating from the Electronic Systems Engineering Technology program should *possess* an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.

SLO2: Function Effectively on Teams

The students graduating from the Electronic Systems Engineering Technology program should *possess* an ability to function effectively as a member or leader on a technical team.

SLO3: Effective Written and Oral Communications

The students graduating from the Electronic Systems Engineering Technology program should *possess* an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.

SLO4: Professionally and Ethically Responsible

The students graduating from the Electronic Systems Engineering Technology program should *possess* an understanding of and a commitment to addressing professional and ethical responsibilities including a respect for diversity.

Targets for all SLOs:

M1 & M3: 3.5/5.0; M2: 80% of the relevant course learning outcomes are being attained successfully.

Once established, the mission statement, goals, learning outcomes, and targets do not need to be recreated every cycle. Minor revisions may be necessary.

Measure and analysis

Once the assessment data are collected, the ESET curriculum committee analyzes the data. Statistical analysis is performed on the raw data. The average score and the standard deviation are first calculated for each measure and each SLO. Table 1 shows the results from the 2015-2016 cycle report. The "faculty" column is the course evaluation by the faculty members. It only indicates a percentage of how many relevant course objectives have an 80% or higher pass rate. Therefore, only the average can be calculated, but there is no standard deviation for this category. The other two measures, IAC and Senior Exit Survey, have both the averages and standard deviations.

Table 1. Summary of assessment measures from the 2015-2016 cycle

Student learning outcomes	IAC(std)	IAC(avg)	Exit (std)	Exit(avg)	faculty	aggreg.
0: Knowledge of Tools and Skills	0.77	4.4	4.38	0.59	98%	4.56
1: Application of Design	0.88	4.2	4.52	0.68	95%	4.49
2: Function Effectively on Teams	0.81	4.2	4.71	0.68	100%	4.64
3: Effective Written and Oral Communications	0.74	4.3	4.29	0.51	95%	4.45
4: Professionally and Ethically Responsible	0.86	4.3	4.29	0.46	100%	4.53
average	0.812	4.28	4.438	0.58	98%	4.53

The sample size for IAC is 24 and the sample size for senior exit survey is 21. The sample sizes are not too small, therefore we can use the Central Limit Theorem to approximate the mean values by normal distributions[1]. With this approximation, the 90% confidence level the confidence intervals for the population means for the IAC and Senior Exit Survey measures are can be calculated with the following formula

$$(\bar{X} - 1.96\frac{\sigma}{\sqrt{n}},\ \bar{X} + 1.96\frac{\sigma}{\sqrt{n}})$$

where $\bar{X}$ is the sample average, n is the sample size, and σ is the sample standard deviation. Using the data in Table 1, the following conclusions can be made with 90% confidence level:

- For SLO0: The population mean for the IAC measure is (4.14, 4.66). The population mean for the Senior Exit Survey measure is (4.17, 4.59).
- For SLO1: The population mean for the IAC measure is (3.90, 4.50). The population mean for the Senior Exit Survey measure is (4.28, 4.76).
- For SLO2: The population mean for the IAC measure is (3.93, 4.47). The population mean for the Senior Exit Survey measure is (4.47, 4.95).
- For SLO3: The population mean for the IAC measure is (4.05, 4.55). The population mean for the Senior Exit Survey measure is (4.11, 4.47).
- For SLO4: The population mean for the IAC measure is (4.01, 4.59). The population mean for the Senior Exit Survey measure is (4.12, 4.46).

The faculty committee would first look at the aggregated values for the five SLOs. The faculty course evaluation needs to be converted to the same scale first, by multiplying the corresponding percentages in Table 1 by 5. For example, a 75% score will be converted to 3.75. Next, the average values for all three measures will be studied to look for any areas of weakness. For the

IAC and Senior Exit Survey measures, the 90% confidence intervals are reviewed as well. Any value below the target of 3.5 will lead to further investigation of the raw data. The next step is to conduct the trend analysis. Sometimes, the scores can be acceptable; however, if the trend is going down, it should set a flag for further investigation. Figs. 2, 3, and 4 show the trend analysis for the three measures over the last three years. Both the IAC and Senior Exist Survey indicate that the 15/16 results have been improved compared to previous years. The faculty course evaluation for SLO3 is worse than previous years; however, the scale (92%-101%) is different from other two graphs (0-5). 95% is still a very good result.

Unlike the mission statement, goals, and SLOs, the data collection, data analysis must be performed every cycle.

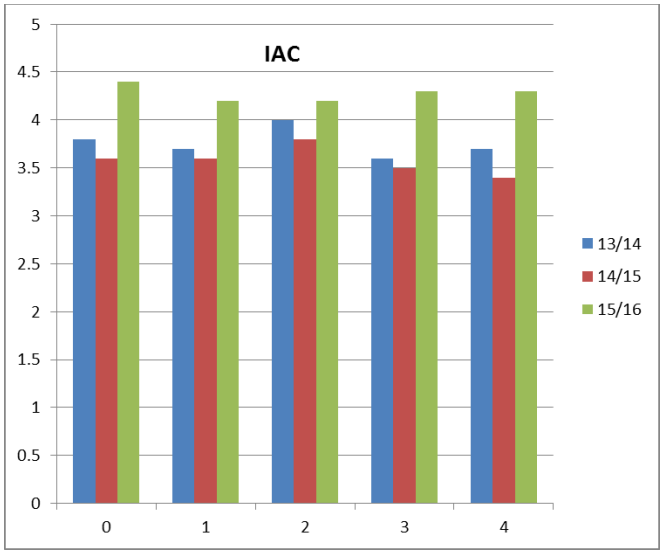

Figure 2. Trend analysis for IAC measure

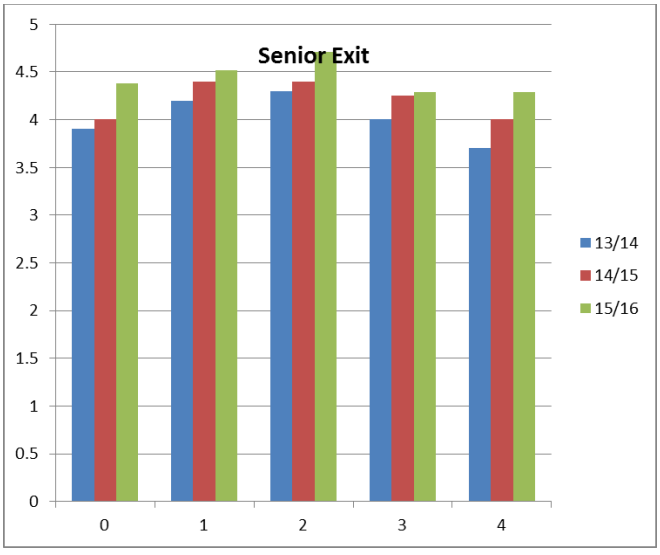

Figure 3. Trend analysis for Senior Exit Survey measure

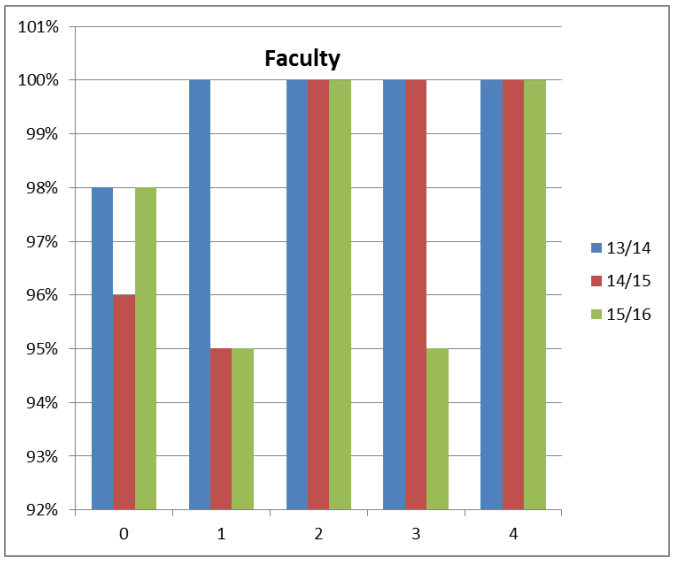

Figure 4. Trend analysis for faculty course evaluation

Action plans

Based on the data analysis, each program is required to have action plans in place for the next cycle. This is a key step in the continuous improvement process. Texas A&M University requires at least one action plan regardless of the scores from the measures. A red flag will be set if there is action plan for the next cycle. The following example of action plan for ESET shows the information in one of the action pans.

Effective Written and Oral Communications

While we made significant improvement in almost all areas, the Effective Written and Oral Communications has the lowest overall average score (4.45) among the 5 areas. The other 4 areas have an average of 4.64. The trend over the last three years also indicates that this is a relative weak area. We need to continue to work on this area so that the score will not go back to a low level. Although the overall score may not be the best indicator, we decided to focus on this area for improvement during this cycle.

Established in Cycle: 2015-2016 Implementation Status: Planned Priority: High
Relationships (Measure | Outcome/Objective):

Measure: Course Objectives Assessment | Outcome/Objective: Effective Written and Oral Communications

Measure: IAC Capstone Evaluation | Outcome/Objective: Effective Written and Oral Communications

Measure: Senior Exit Survey | Outcome/Objective: Effective Written and Oral Communications

Implementation Description: Effective Written and Oral Communications will be included in the course objectives of ESET 329 and ESET 359. Students will be asked to present their course project and submit a written project report. The quality of their presentation and the final project report will be used in the final grades.

Projected Completion Date: 04/30/2017 Responsible Person/Group: Dr. Zhan

Additional Resources Requested: None

There is a section for "Analysis Questions and Analysis Answers" where the programs need to answer the following question: "Based on the analysis of your findings, what changes are you currently making to improve your program? Identify the specific findings you analyzed and how they led to your decision."

Conclusions and discussion

It takes a lot of effort to complete the WEAVEonline report for the first time. Many items, such as the mission statement, the goals, the measures, and the target values, just need minor revision afterwards. If properly done, assessment data for ABET can be reused for WEAVEonline. The data analysis and action plans can be used in ABET accreditation as evidence for the existence of a continuous improvement process. The data analysis part can also be streamlined by creating an Excel program. After the first time, each year raw data can be copied to the Excel program to get the averages, standard deviations, and the confidence intervals. The ESET WEAVEonline report was selected as one of the two examples of good assessments at TAMU.

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Jay Porter

Jay R. Porter joined the Department of Engineering Technology and Industrial Distribution at Texas A&M University in 1998 and is currently a Professor and the Associate Department Head. He received the BS degree in electrical engineering (1987), the MS degree in physics (1989), and the Ph.D. in electrical engineering (1993) from Texas A&M University. His areas of interest in research and education include product development, analog/RF electronics, instrumentation, and entrepreneurship.