AC 2007-245: SIX YEARS AND THOUSANDS OF ASSIGNMENTS LATER: WHAT HAVE THEY LEARNED, AND WHAT HAVE WE LEARNED?

J. Shawn Addington, Virginia Military Institute

J. Shawn Addington is the Jamison-Payne Institute Professor and Head of the Electrical and Computer Engineering Department at the Virginia Military Institute. He received his B.S., M.S., and Ph.D. degrees in Electrical Engineering from Virginia Polytechnic Institute and State University. He teaches courses, laboratories, and undergraduate research projects in the microelectronics and semiconductor fabrication areas; and, he remains active in curriculum development and engineering assessment. He is a registered professional engineer in the Commonwealth of Virginia, and is a member of ASEE, IEEE, and several other engineering professional and honor societies.

Six Years and Thousands of Assignments Later: What Have *They* Learned, and What Have *We* Learned?

Abstract

Following the birth of Engineering Criteria 2000, many programs have since had the opportunity to fully develop, evaluate, and revise their assessment schemes. Most importantly, programs have now had ample opportunity to use feedback from these assessment schemes to effect improvements within their programs. The purpose of this paper is to illustrate both the formative and summative phases of assessment that have been, and continue to be, used in the Electrical and Computer Engineering Department at this institution. The paper begins with an overview of the overall assessment system utilized by this program, including program-level and course-level assessments and the various feedback loops associated with each. Among the many assessment tools being utilized by the program is the use of student performance data to enable (1) real-time formative feedback to the instructor, regarding student achievement at the course-level, as well as (2) the summative evaluation of outcomes achievement at the program-level, in both short-term and long-term studies. While significant consideration is given to the assessment *processes*, this paper will focus on the important, overarching issue of how the data from these processes *have been used* to effect program changes, evaluate the effectiveness of previous program changes, validate program direction and philosophy, and influence future planning at both the program- and course-levels.

In recent years, there have been a significant number of publications that report on the various assessment strategies being employed by numerous institutions; however, there appear to be very few strategies that have matured to the point of being able to provide details on *the use of the data* gathered from these schemes, especially over the long-term. This paper attempts to address this apparent deficiency of information, and hopefully initiate further discussions and refinements on the topic.

Introduction

"Assessment isn't a once-and-done project… It is, instead, a continuous cycle of raising questions and finding some answers that raise more questions."[1]

With the advent of EC 2000 came a dramatic shift from the oft-referenced "bean-counting" approach to a primarily "outcomes-based" approach to engineering assessment. For several years thereafter, institutions struggled with this transition and the inherent need to develop radically different assessment processes. Common questions such as "How do I measure that?", "What is the difference between an outcome and an objective?", "What, and how much, data do I need?" dominated the attention of programs around the country during their planning stages.[2,3,4,5,6,7,8] As a result, important questions like "How can I use these data to improve my course and my program?" were often deferred to a later date when more data were available and/or when assessment plans had matured sufficiently. Until then, programs could only offer limited, primarily qualitative, evidence of the use of assessment data in effecting program improvement.[8,9,10] Only recently have some institutions been able to gather sufficient quantitative data from their evolving assessment mechanisms to report on specific program improvements. However, these reports are often limited in scope, encompassing data from only a few courses over a period of only a few years.[11,12,13,14]

A focus of this paper, therefore, is to provide some long term evidence of course- and program-level changes, improvements, and plans that have resulted from the careful evaluation of assessment data collected over the past six years.

Assessment Strategies

The Electrical and Computer Engineering Department utilizes a two-tiered outcomes-based assessment mechanism, including *program-level* assessment and *course-level* assessment, which focuses on continual evaluation and improvement of the program. A visual representation of the departmental assessment system is shown below (Figure 1).

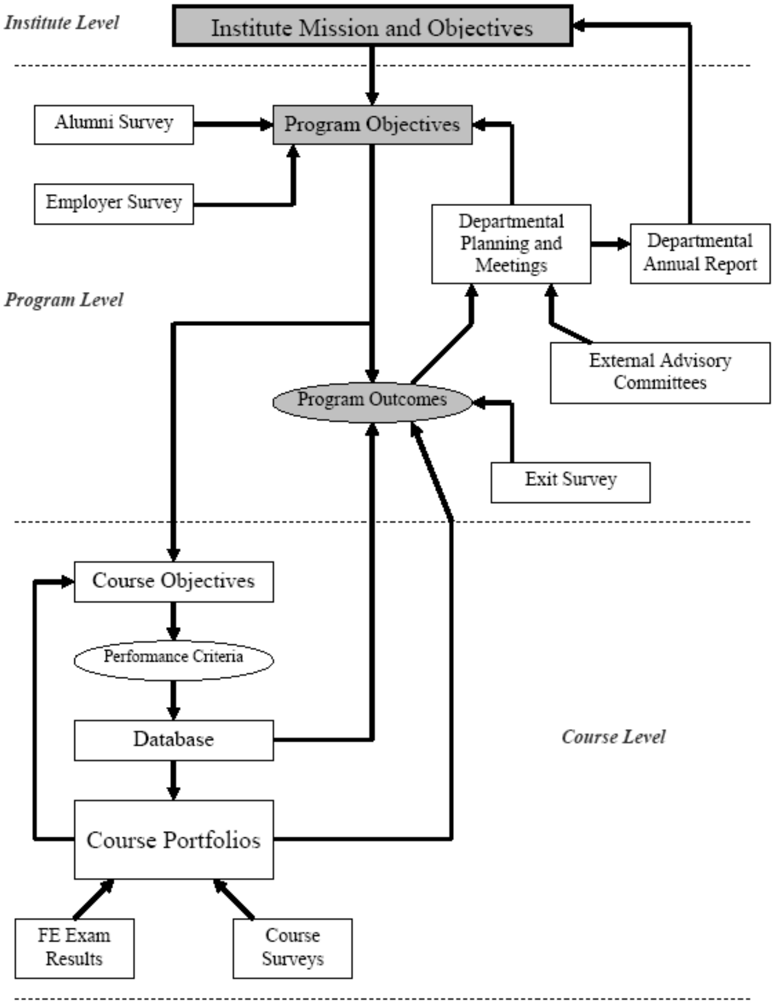

Figure 1

Program Level Assessment:
At the *program-level*, the evaluation system begins with the establishment of Program Objectives that support the Institute Mission and Objectives. The Program Objectives describe *characteristics that our graduates are expected to demonstrate during the first 1-3 years after graduating from the program.* (Appendix 1)

In order to evaluate the extent to which the department is meeting its Program Objectives, the department relies on feedback from *two sources*: external advisory committees and alumni/employer surveys. First, the Engineering Division Advisory Committee (EDAC), serving multiple engineering departments at this institution, is comprised of representatives from industry, academia, and the alumni. Currently, the EDAC ECE membership consists of a single representative from each of these three constituencies; however, attempts are being made to double the representation. A crucial role of EDAC is to regularly (annually) evaluate the appropriateness of the ECE Program Objectives in addressing the rapidly changing needs of our post-graduate constituencies. Specifically, this group provides multiple perspectives on the skills that our graduates need to have in order to be successful in their post-graduate activities. In addition, the ECE Program regularly (every 5 years) sends out Alumni Surveys to its recent graduates (with a return rate of approximately 10%). These Alumni Surveys consist of two parts. The first part of the survey, to be completed by the alumni, inquires as to the extent to which the alumni feel that the ECE Program has prepared them for their post-graduate work, in terms of the Program Objectives. The second part of the survey, to be completed by the alumni's employers (direct supervisors or graduate advisors), asks for a similar assessment of the alumni's preparation, again in terms of the Program Objectives.

The Program Objectives directly inform the Course Objectives for *every* course in the ECE Program of Study. An excerpt from one course syllabus is shown in Appendix 2. This will be discussed in more detail in the section on Course Level Assessment.

In order to meet the post-graduate needs (Program Objectives) of our students, the ECE Department has established a set of 16 measurable Program Outcomes that describe the skills that our current students are expected to develop in order to graduate from the program. Of course, these Program Outcomes are directly tied to the Program Objectives, as shown in Appendix 3. Although the Program Outcomes have changed slightly over the years, in response to ABET's reorganization of its Criteria, this has had minimal impact on the department's assessment process. Appendix 3 displays the most recent version of the Program Outcomes. A cumulative assessment of student achievement on each of these Program Outcomes is performed through an Exit Survey conducted for all graduating seniors. A more thorough, continuous, and objective assessment of student achievement on the Program Outcomes is performed at the *course-level*, as described below.

Course Level Assessment:
Each course in the ECE Department has a published set of measurable Performance Criteria that are directly linked to the Course Objectives that have been developed to support the Program Objectives of the ECE Department. An excerpt from one course syllabus is shown in Appendix 2.

As illustrated in Figure 1, it is important to note that while all ECE Course Objectives are informed by the post-graduate needs outlined in the Program Objectives, the Course Objectives *cannot* provide a direct measure of departmental achievement of Program Objectives. This assessment is performed by using feedback from advisory committees and alumni/employer surveys, as described above. Instead, the Course Objectives and their associated Performance Criteria, shape the design of course topics and assignments.

Since these Performance Criteria are tied to specific assignments within the course, a direct measurement of achievement of Course Objectives through the evaluation of student performance data (grades on individual assignments) is possible. Note that each assignment is also labeled with a measure of the extent (on a scale of 0 (low) to 5 (high)) to which it addresses the 16 Program Outcomes, thus allowing a *course-level* measurement of achievement of Program Outcomes through the evaluation of student performance data. Please see Appendix 4.

All of these data are compiled in the Departmental Course Assignment Database, in order to allow both *course-level* and *program-level* assessment. At the *course-level*, the Database is used by the ECE faculty in the preparation of their Course Portfolios. The Course Portfolios offer each faculty member the opportunity to reflect on the effectiveness of each of his courses, primarily in terms of the desired Course Objectives, and their associated Performance Criteria. Through this mechanism, the faculty member can evaluate student strengths and weaknesses in meeting Course Objectives by identifying the specific curricular topics and assignments that have contributed to the level of achievement, and making appropriate changes for the next course offering. In addition, to demonstrate the power and flexibility of this system, a faculty member may perform such assessment in a variety of ways: (1) real-time as grades are entered during the semester (so changes can be made immediately, rather than waiting until the next course offering), (2) at the conclusion of each semester, and (3) longitudinally over the course of several years to allow an evaluation of continual course improvement. In addition, the Course Portfolio contains student perception of achievement data, obtained from the Course Survey. All of this information is also accompanied by the nationally normed Fundamentals of Engineering (FE) Examination data, as well as Student-tracking and Placement Data, both of which provide external assessment of student achievement. At the *program-level*, the Database data from all departmental courses provide a cumulative and objective assessment of the extent to which the ECE students are achieving their 16 Program Outcomes.

Assessment Results

A professor of chemistry once said, “If you torture data sufficiently, it will confess to almost anything.”[11] As such, the importance of the interpretation and use of data from assessment schemes cannot be understated. While course-embedded approaches to program assessment have garnered much attention, both positive and negative,[12,13,14,15,16] the specific methods implemented by programs continue to vary by necessity.

Consider the following scenario, for example:
An assignment is labeled as a performance indicator for a particular Course Objective or Program Outcome. A 70% score on the assignment is determined to be the minimum level of achievement for the indicator. Ten students in Class A and ten students in Class B complete the

assignment. In both classes, 60% of the students achieved a score of at least 70% on the assignment. In Class A, the class average on the assignment is 72%, while in Class B, the class average is 54%. How shall these results best be interpreted?

The answer, of course, depends on the individual program and its use of the assessment data. The following examples highlight how these and other types of assessment data are being used in the Electrical and Computer Engineering Department at this institution.

Of course, an assessment scheme that utilizes student performance data must trust the judgment of the faculty in assigning grades that are representative of student achievement on individual assignments. Some variation among faculty grading styles is unavoidable. Fortunately, in this department, there are no multiple sections of the same course that are taught by different instructors. Early versions of this department's assessment scheme[9, 10] incorporated statistical measures to "normalize" department-wide data against varying teaching styles. However, these statistical measures provided minimal useful feedback to the faculty, due primarily to the significant number of small class (sample) sizes within the department, and were soon discontinued. Instead of replacing this statistical measure with another, the departmental focus turned to using Course Portfolios to allow instructors to reflect on the significance and validity of the database data, rather than relying on statistical analyses.

First, consider the assessment of a single course within the program. Recall that each assignment in the course is linked to specific Performance Criteria that support defined Course Objectives. In addition, each assignment is linked to specific Program Outcomes. In this manner, each instructor may analyze not only the extent to which Course Objectives are being met, but also the extent that a course is supporting the Program Outcomes. Formative assessment capabilities are possible, as changes may be made as the course progresses. In addition, summative assessments may occur at the conclusion of the course in comparing to previous years and preparing for the next year. The graph below (Figure 2) illustrates overall student performance on assignments in this course that address each Program Outcome to a "significant extent" (that is, 3 or higher on the scale from 0 to 5 - see Appendix 4). Note that there are no assignments in this particular course designed to address the skills outlined in Program Outcome #4. While the ECE Department considers 70% to be the minimum overall average grade for a Program Outcome to be "adequately met", it is just as important to evaluate any "outliers" - Program Outcomes for which the overall student performance was significantly lower than that the overall course average, regardless of the 70% threshold. In this example, it is clear to see that there is one primary outlier (Program Outcome #13), but also three others (#3, 8, and 14) that require some attention. Simple reliance on statistics, alone, would possibly overlook these borderline Outcome achievement levels.

Student Performance on Assignments Addressing Each Outcome

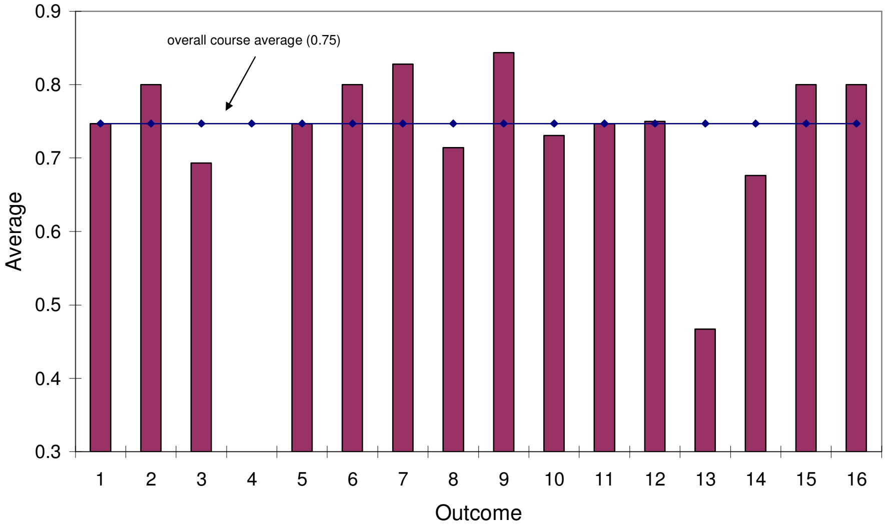

Figure 2

Using the links discussed earlier and illustrated in Appendix 4, these deficiencies are identified by individual course topics and assignments. Consequently, during the "reflection" portion of the instructor's Course Portfolio, specific changes were proposed and adopted for the next year in an attempt to address these concerns. These changes included an increased emphasis on the topics requiring the use of advanced mathematical concepts, as well as the addition of laboratory progress reports to reinforce overall design concepts. A comparison with the results from the subsequent year illustrates that, while the attempts to improve the students' mathematical abilities were less successful (7% decline), there was a slight (2.5%) improvement in the student performance on assignments supporting Outcome #3 (Figure 3).

2006 vs 2005 Comparison

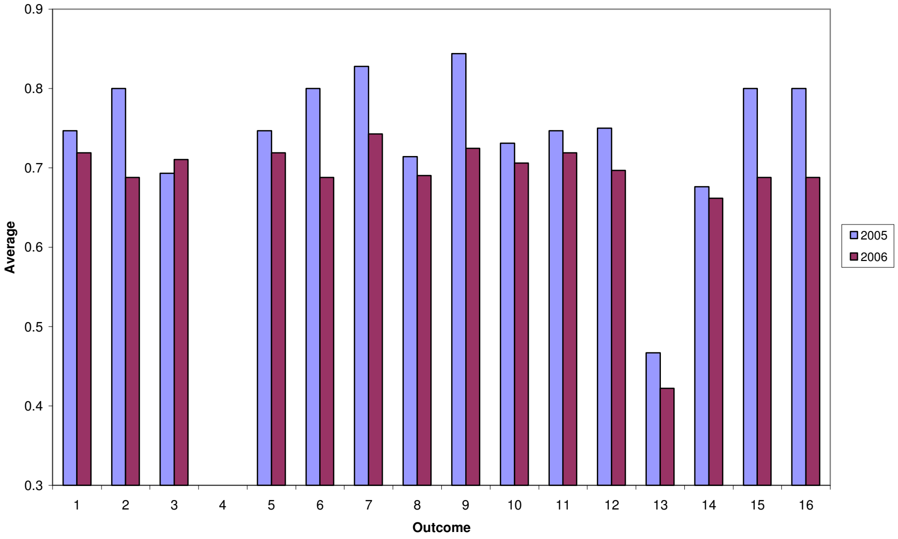

Figure 3

This example speaks to the inherent need to evaluate the meaning of the statistical data, rather than rely solely on numerical results from any course-embedded assessment technique. As such, the aforementioned Faculty Course Portfolios, instead of statistical confidence testing, play a critical role in this process. As part of the Faculty Course Portfolio, each instructor may also evaluate objective and subjective data related to the achievement of Course Objectives and their associated Performance Criteria. Students, especially those in the early stages of the program, are often unable to grasp the full meaning behind the higher-level Program Outcomes, and thus cannot provide a true subjective measure of their perceived achievement of skills pertaining to these Outcomes. However, students can easily relate to, and therefore provide a self-assessment of, their achievements as they pertain to published Course Objectives and Performance Criteria. Again, due to the links between the Course Objectives/Performance Criteria and individual course assignments (Appendix 2), each instructor may easily identify the sources of any strengths and deficiencies using these data. This information often complements the data provided by the above graphs and analyses.

In addition to the above assessments, the Faculty Course Portfolios also contain student performance data on course-specific topics on the Afternoon Session of the Fundamentals of Engineering (FE) Examination. During their senior year, all ECE students at this institution are required to take the FE Examination, as well as the ECE Discipline-Specific Afternoon Portion, as a graduation requirement. While overall pass rates are used for program-level assessment (discussed later), student performance on subdisciplinary portions of the FE Examination are used, when applicable, within the Faculty Course Portfolios. As illustrated in Figure 1, the FE Examination data are *not* used to directly evaluate Program Outcomes achievement. Instead, the data provide important feedback to course instructors regarding student performance on examination topics pertaining to their specific courses. An excerpt from one of these Portfolios is included in Appendix 5.

At the program-level, data from all ECE courses are incorporated into a database, allowing a summative analysis of the extent to which the overall ECE program is meeting its Program Outcomes each year. An example of this is shown below (Figure 4).

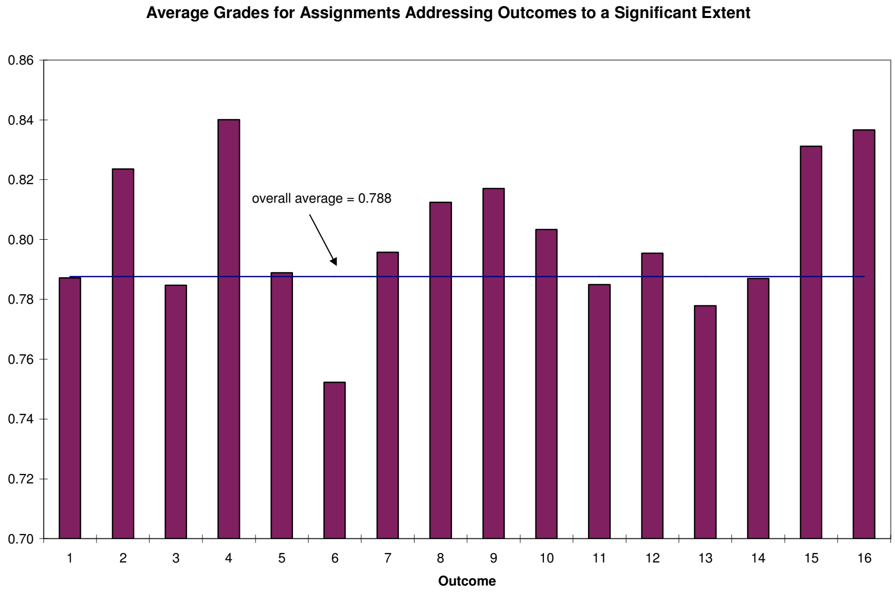

Figure 4

The above graph provides a snapshot of an entire academic year, and allows for some conclusions to be made regarding overall program achievement of its Outcomes. For instance, all of the average grades exceed the 70% minimum level mentioned earlier, and (with the possible exception of #6), there are no negative outliers. However, it must be understood that there will likely be fluctuations from year to year, requiring the need for long-term analyses to better evaluate the direction of the program. Among the various comparisons that may be performed, as a result of gathering such data from multiple academic years, is the following long-term comparison between two three-year averages (the 00-01 through 02-03 3-year average compared to the 03-04 through 05-06 3-year average) (Figure 5).

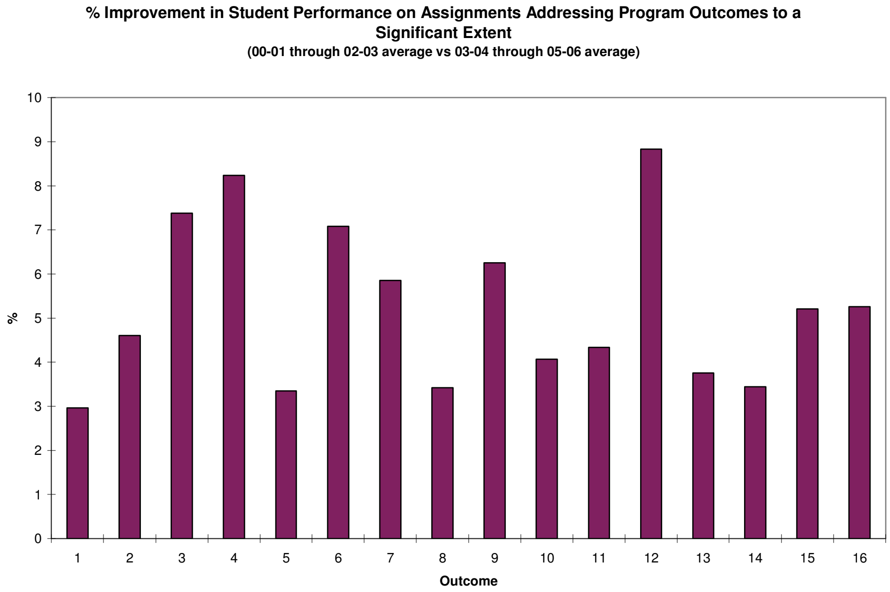

Figure 5

Such an analysis speaks to the continuous improvement efforts that are being made by the ECE Department at this institution. Of primary significance in Figure 5 are not the specific percentages, but the overall positive *trend* in regard to student performance on assignments that support the Program Outcomes. In addition, the data gathered from this assessment approach may also be used to evaluate program changes that were implemented years ago.

For example, a number of years ago (before this assessment approach had begun), the ECE Department made a concerted effort to increase the amount of design throughout its curriculum, and to enhance student performance in the area of probability and statistics. In the old “bean-counting” approach to assessment, it is easy to address these issues by simply increasing the number of courses that have a significant design component, or by increasing the number of credits in the capstone design sequence, or even by adding a required course in probability and statistics. However, these tactics, alone, provide no measure of their effectiveness in terms of meeting desired Program Outcomes. Now, using the course-embedded assessment scheme adopted by this institution, a true long-term analysis of the impact of these changes may be performed.

For example, the graph below (Figure 6) indicates the percentage of all departmental assignments that address engineering design (Program Outcome #3) to a significant extent.

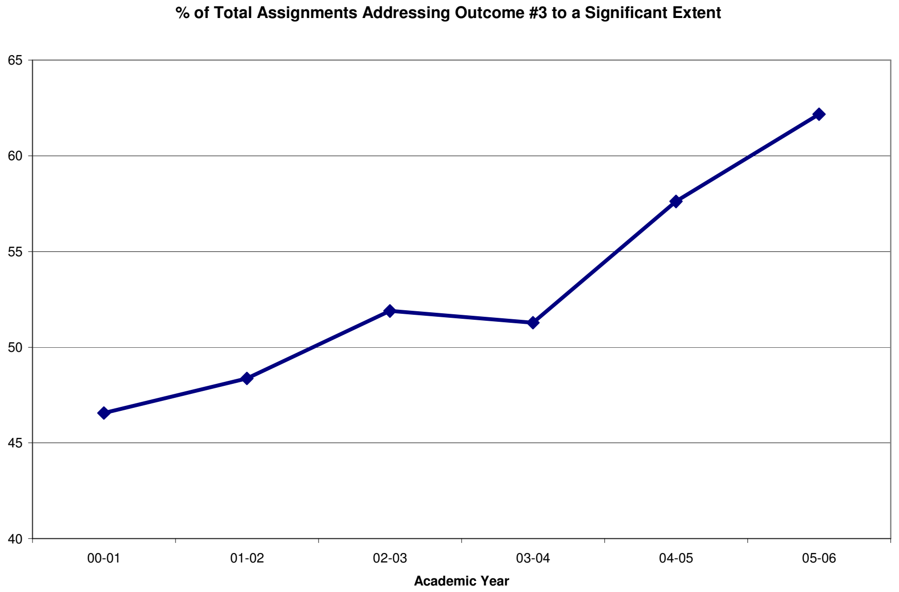

Figure 6

Likewise, a measure of overall student performance on assignments that address this Outcome to a significant extent is provided below (Figure 7).

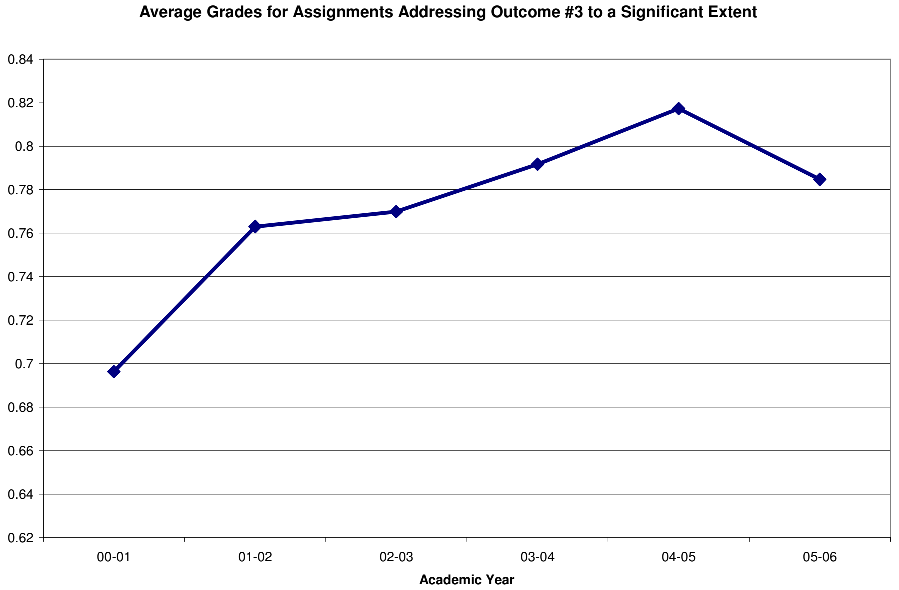

Figure 7

These graphs provide clear evidence that the program is indeed increasing its emphasis on engineering design, and that the students are progressively improving in this area. These are powerful measures that can be obtained by no other means than the course-embedded assessment approach used by this program.

Regarding the use of probability and statistics (Program Outcome #12), the following graphs (Figures 8 and 9) provide similar validity to student improvement in this area, as well; although, emphasis has remained essentially static over recent years.

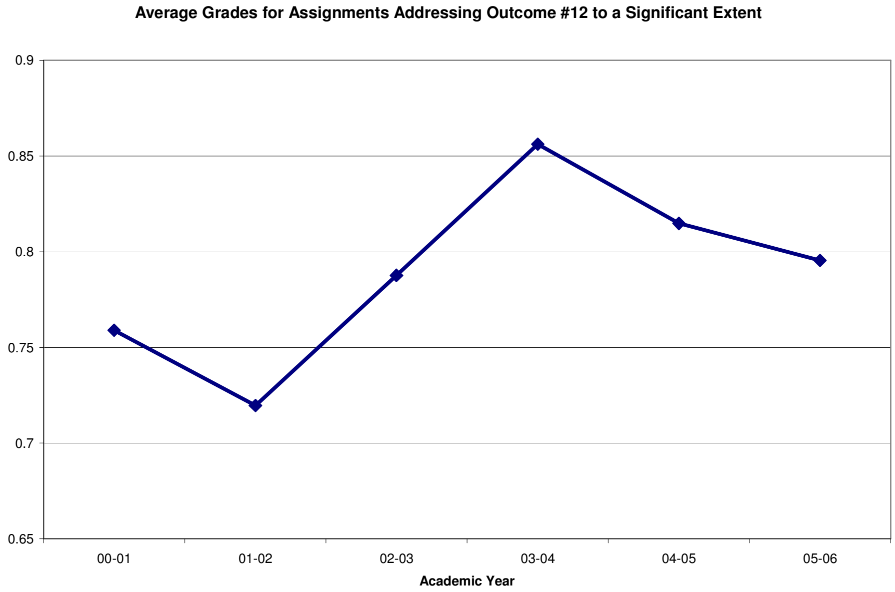

Figure 8

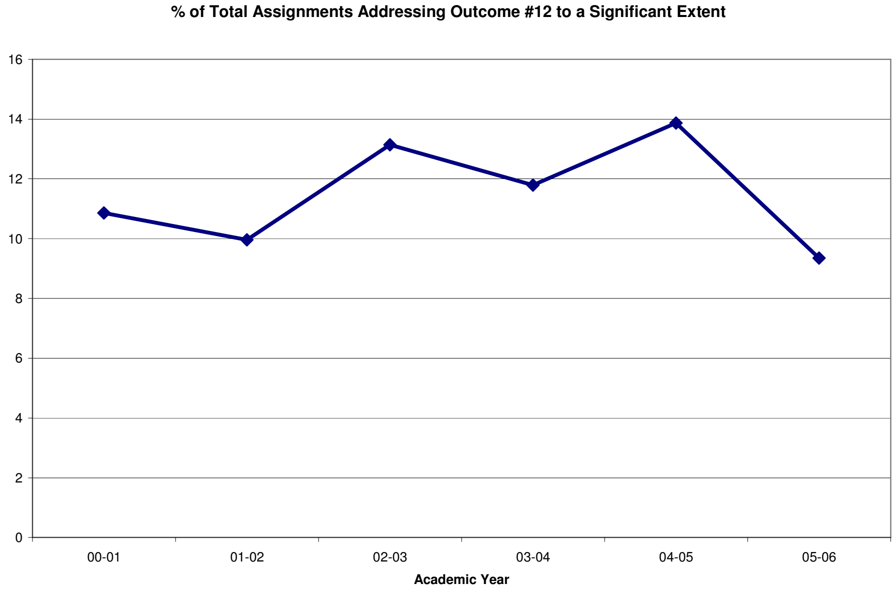

Figure 9

Of some concern to the program is the relatively low percentage of assignments that pertain to several of the Program Outcomes, as well as the recent decline in the percentage of departmental assignments that address the use of advanced mathematics (Program Outcome #13), as illustrated in the graphs below (Figures 10 and 11). This will be a point of discussion in departmental planning this year.

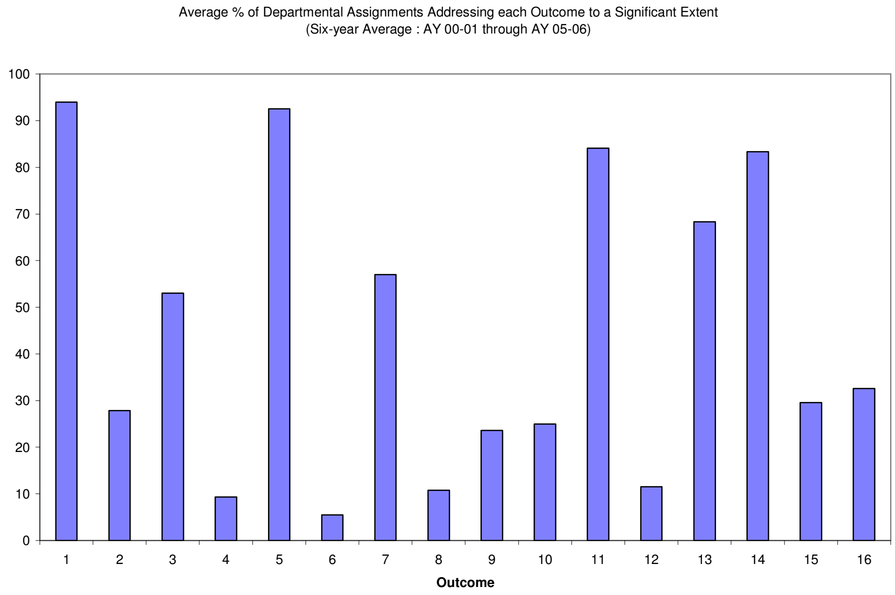

Figure 10

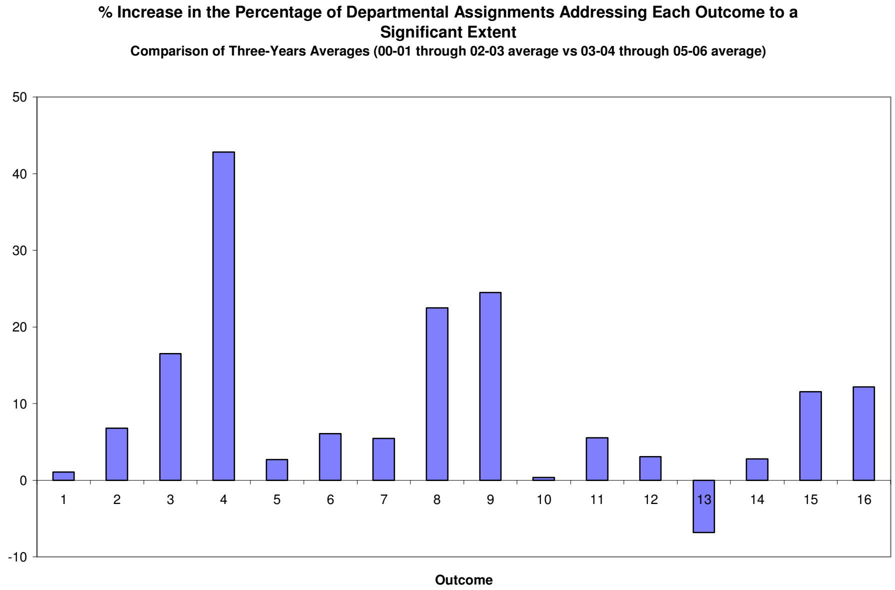

Figure 11

On the other hand, the program is especially pleased with the increased emphasis on engineering design and teamwork (Program Outcomes #3 and 4), as well as the high level of student performance on assignments pertaining to Program Outcomes #15 and 16 that reflect the program's mission to provide a strong practical experience to complement a solid theoretical foundation. Please recall Figures 4, 5, and 10.

While course-level assessments are complemented with subjective data from course surveys of student achievement in Course Objectives, and comparisons to normative data from the FE Examination, program-level assessments are complemented by an exit survey and the overall pass rates on the FE Examination.

By the time they are ready to graduate from the program, students have gained a better perspective on the significance of the 16 Program Outcomes and the contributions from the courses in the curriculum. As such, the Exit Survey, administered each year, asks the students to provide a self-assessment of their achievements (on a scale from 1 (low) to 5 (high)), regarding these Program Outcomes (Figure 12). Such subjective data are compared to the objective program data described above in evaluating the effectiveness of the program. All of these data are compiled in the Departmental Annual Report, for which the department receives feedback from the administration. Again, the raw data are much less important than the relations between the data (i.e. outliers). Likewise, as more Exit Surveys are administered, more useful comparisons and long-term trends may be made. Given recent changes to the Exit Survey format, such comparisons are not yet available.

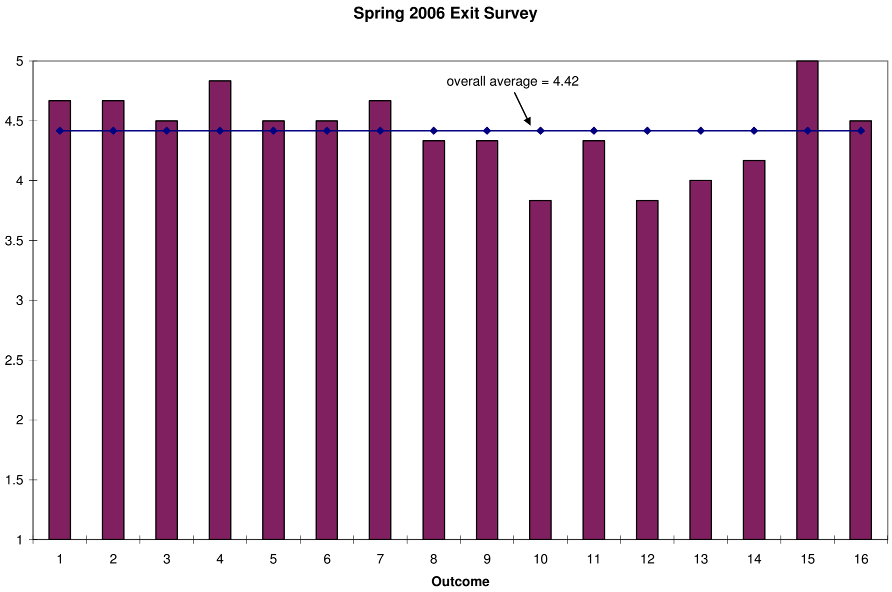

Figure 12

Similarly, overall pass rates on the nationally-normed FE Examination provide a comparison of student achievement to other programs in the state and around the country. The graphs below (Figures 13 and 14) are representative of how these data may be used in program-level assessment. Again, while subdiscipline scores are used by individual faculty in their Course Portfolios, the overall pass rates provide normative data to complement the objective and subjective data presented in the Departmental Annual Report.

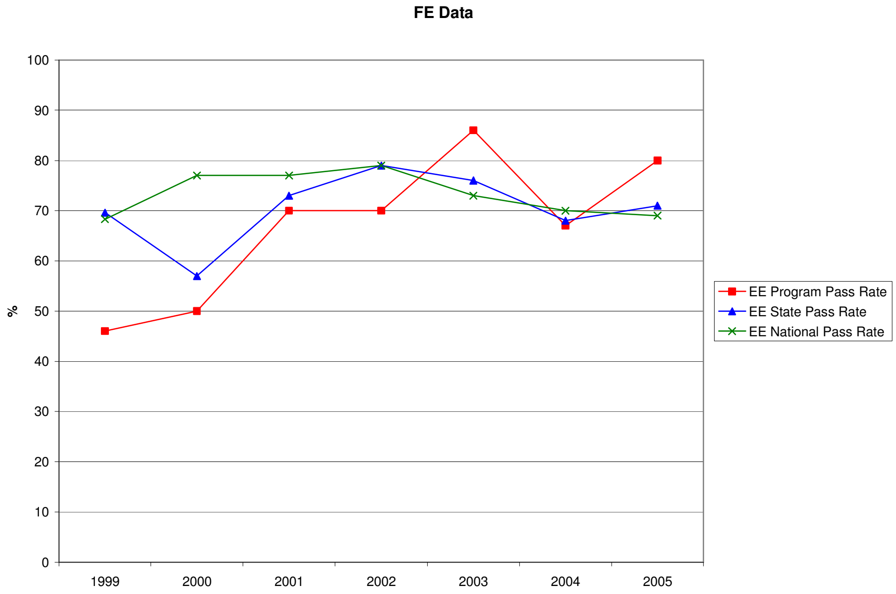

Figure 13

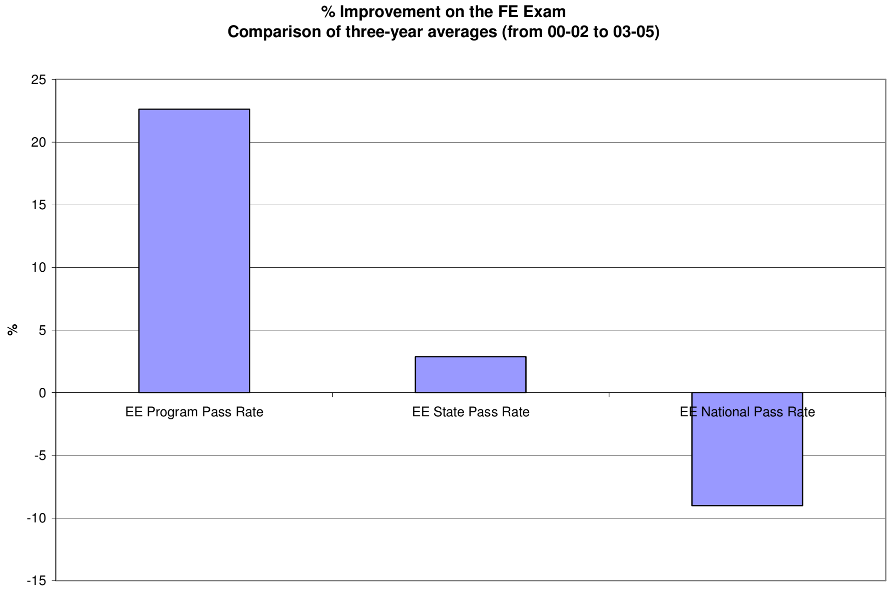

Figure 14

Conclusions

This paper provides a representative sampling of the use of assessment data at this institution. The approach combines both formative and summative means of assessment, using objective, subjective, and normative data. The careful evaluation of course-embedded student data, from assignments linked to Course Objectives and Program Outcomes, provides a key point of reflection for faculty both during the course, as well as at its completion. In recent years, many assessment systems have been proposed, several have been modeled, and only a few have been attempted in limited trial form. This paper is unique in the sense that it can demonstrate the use of assessment data from a program-wide system that has matured sufficiently to provide over six years of data. Nevertheless, this system must continue to evolve, with the understanding that "All assessment is a perpetual work in progress."[17]

The author wishes to thank his colleagues in the Electrical and Computer Engineering Department for their assistance in utilizing this assessment scheme over the years. The author also wishes to thank the reviewers of this paper for their insight and constructive suggestions.

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Appendix 1

Program Objective A : " The electrical and computer engineering curriculum will produce graduates who are prepared for continuing education, professional growth and career advancement."

Program Objective B : " The electrical and computer engineering curriculum will produce graduates who have effective analytical and communications skills."

Program Objective C : " The electrical and computer engineering curriculum will produce graduates who are able to design components and systems."

Program Objective D : " The electrical and computer engineering curriculum will produce graduates who have broad laboratory skills, including extensive teamwork and hands-on practical abilities."

Program Objective E : " The electrical and computer engineering curriculum will produce graduates who are aware of current and emerging technologies and professional engineering practices."

Appendix 2

Course Objectives[1]:

1. Develop a basic understanding of the theory of semiconductors and electronic devices [A]
2. Develop the skills necessary to analyze and design electronic circuits and systems [A,B,C]
3. Develop a familiarity with the performance characteristics of basic integrated circuit classes [A]
4. Develop laboratory skills in the construction and analysis of electronic circuits [A,B,C,D,E]

[1] Letters in brackets correspond to departmental program objectives

<u>Performance Criteria</u>:

for Objective 1:

a. Students will demonstrate an understanding of basic semiconductor theory, including the concepts of doping and diffusion. [HW1, HW2, Q1, EXAM]

b. Students will demonstrate an understanding of pn junction operation, biasing, and current. [HW2, LAB1, Q1, EXAM]

c. Students will demonstrate an understanding of the internal semiconductor characteristics of diodes and BJT/FET transistors. [HW3, HW4, HW6, LAB1, LAB3, LAB5, LAB8, LAB9, LAB11, Q1-3, EXAM]

for Objective 2:

a. Students will demonstrate an understanding of diode and BJT/FET operating modes. [HW3, HW4, HW6, LAB1, LAB3, LAB4, LAB5, LAB8, LAB9, LAB11, Q1-3, EXAM]

b. Students will demonstrate an understanding of electrical modeling of diodes and BJT/FET transistors. [HW3-7, LAB1-11, Q1-3, EXAM]

c. Students will demonstrate an understanding of electrical circuit analysis, as applied to the DC and AC evaluation of circuits containing diodes and BJT/FET transistors. [HW3-7, LAB1-11, Q1-3, EXAM]

for Objective 3:

a. Students will demonstrate an understanding of characteristic curves and equations associated with diodes and BJT/FET transistors. [HW3-7, LAB1, LAB3-5, LAB8, LAB9, LAB11, Q1-3, EXAM]

b. Students will demonstrate an understanding of the characteristics of BJT and FET operating configurations, including CB, CE, CC, CS, and CD. [HW5, HW7, LAB6, LAB7, LAB10, LAB11, Q2, Q3, EXAM]

for Objective 4:

a. Students will demonstrate an ability to apply course concepts to the understanding of laboratory circuits, containing diodes and BJT/FET transistors. [LAB1-11]

b. Students will demonstrate an ability to simulate, construct, test, evaluate, and troubleshoot circuits in the laboratory environment. [LAB1-11]

c. Students will demonstrate the ability to prepare technical reports. [LAB1-11]

Appendix 3

Program Outcome #1 : "An ability to apply knowledge of math, science, and engineering"
Program Outcome #2 : "An ability to design and conduct experiments, as well as to analyze and interpret data"
Program Outcome #3 : "An ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability"
Program Outcome #4 : "An ability to function on multi-disciplinary teams"
Program Outcome #5 : "An ability to identify, formulate, and solve engineering problems"
Program Outcome #6 : "An understanding of professional and ethical responsibility"
Program Outcome #7 : "An ability to communicate effectively"
Program Outcome #8 : "The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context"
Program Outcome #9 : "A recognition of the need for, and ability to engage in life-long learning"
Program Outcome #10 : "A knowledge of contemporary issues"
Program Outcome #11 : "An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice"
Program Outcome #12 : "A knowledge of probability and statistics, including applications appropriate to electrical and computer engineering"
Program Outcome #13 : "A knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables and discrete math"
Program Outcome #14 : "An ability to acquire new information, assimilate that information into a body of knowledge and apply that knowledge to the solution of problems"
Program Outcome #15 : "An ability to function as a member of a team in project design and laboratory experiment environments"
Program Outcome #16 : "An ability to apply contemporary analytic, computational and experimental practices in the laboratory environment"

	ECE PROGRAM OUTCOMES															
PROGRAM EDUCATIONAL OBJECTIVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A. The electrical and computer engineering curriculum will produce graduates who are prepared for continuing education, professional growth and career advancement.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B. The electrical and computer engineering curriculum will produce graduates who have effective analytical and communications skills.		X	X	X			X	X	X	X	X				X	
C. The electrical and computer engineering curriculum will produce graduates who are able to design components and systems.	X	X	X	X	X	X	X	X			X	X	X	X	X	X
D. The electrical and computer engineering curriculum will produce graduates who have broad laboratory skills, including extensive teamwork and hands-on practical abilities.	X	X	X	X	X		X				X	X	X	X	X	X
E. The electrical and computer engineering curriculum will produce graduates who are aware of current and emerging technologies and professional engineering practices.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix 4

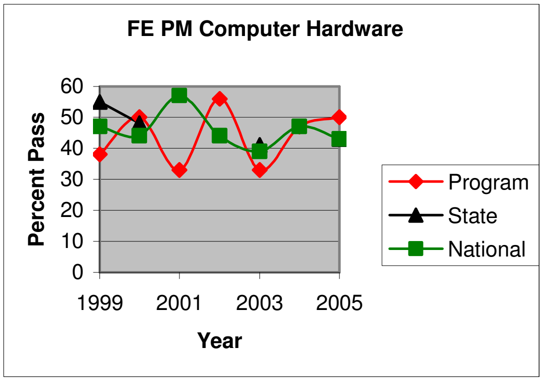
EE355 Fall 2003		Num.	Ave	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	KEYWORDS
HW1	EE355 Fall 2003 HW1	8	0.906	5	0	0	0	5	0	2	2	2	3	5	1	2	5	0	0	semiconductor theory; doping, maj. and min. carriers, energy band diagram
HW2	EE355 Fall 2003 HW2	8	0.863	5	0	1	0	5	0	2	2	2	3	5	0	1	5	0	0	semiconductor theory; mobility, resistivity, conductivity, pn junction char., energy band diagram, biasing
HW3	EE355 Fall 2003 HW3	8	0.775	5	3	3	0	5	0	2	2	2	3	5	0	0	5	0	3	diode circuits; models, analysis, design, and PSpice simulation
HW4	EE355 Fall 2003 HW4	8	0.741	5	0	2	0	5	0	2	2	2	3	5	0	0	5	0	0	BJT; operating modes, biasing design
HW5	EE355 Fall 2003 HW5	8	0.798	5	0	0	0	5	0	2	2	2	3	5	1	2	5	0	0	BJT AC analysis; voltage gain, current gain, input impedance, output impedance
HW6	EE355 Fall 2003 HW6	8	0.713	5	0	4	0	5	0	2	2	2	3	5	0	1	5	0	0	FET; operating modes, bias design
HW7	EE355 Fall 2003 HW7	8	0.772	5	0	0	0	5	0	2	2	2	3	5	0	2	5	0	0	FET AC analysis; voltage gain, current gain, input impedance, output impedance
LAB1	EE355 Fall 2003 LAB1	8	0.9	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	diode, Pspice simulation
LAB2	EE355 Fall 2003 LAB2	8	0.75	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	diode rectifier circuits, diode limiter, Pspice simulation
LAB3	EE355 Fall 2003 LAB3	8	0.763	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	power supply design, zener diode, voltage regulation, Pspice simulation
LAB4	EE355 Fall 2003 LAB4	8	1	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	BJT biasing, I-V characteristic, Pspice simulation
LAB5	EE355 Fall 2003 LAB5	8	0.95	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	BJT biasing, temperature stability, Pspice simulation
LAB6	EE355 Fall 2003 LAB6	8	0.888	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	BJT amplifiers, voltage gain, output resistance, Pspice simulation
LAB7	EE355 Fall 2003 LAB7	8	0.925	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	BJT amplifiers, voltage gain, phase shift, input resistance, Pspice simulation
LAB8	EE355 Fall 2003 LAB8	8	0.8	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	JFET biasing, JFET I-V and transfer characteristic curves, Pspice simulation
LAB9	EE355 Fall 2003 LAB9	8	0.875	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	MOSFET biasing, transfer characteristic, Pspice simulation
LAB10	EE355 Fall 2003 LAB10	8	0.875	5	5	0	0	5	0	3	4	4	4	5	0	0	5	5	5	FET amplifiers, voltage gain, phase shift, Pspice simulation
LAB11	EE355 Fall 2003 LAB11	8	0.87	5	5	5	0	5	0	3	4	4	4	5	1	0	5	5	5	final project; amplifier design, DC and AC analyses, Pspice simulation
Q1	EE355 Fall 2003 Q1	8	0.744	5	0	0	0	5	2	2	2	2	3	5	1	1	5	0	0	semiconductor theory, diode circuit analysis
Q2	EE355 Fall 2003 Q2	8	0.75	5	0	2	0	5	2	2	2	2	3	5	0	1	5	0	0	BJT DC and AC analyses
Q3	EE355 Fall 2003 Q3	8	0.756	5	0	2	0	5	2	2	2	2	3	5	0	1	5	0	0	FET operating modes, DC and AC analyses
EXAM	EE355 Fall 2003 EXAM	8	0.777	5	0	1	0	5	2	2	3	3	3	5	1	2	5	0	0	comprehensive; semiconductor theory, diodes, BJTs, FETs

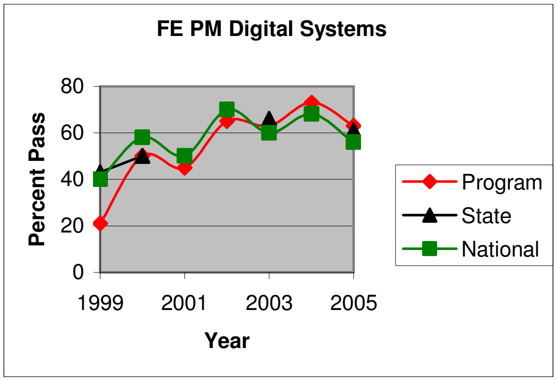
Appendix 5

Example of the Use of FE sub-scores in Course Portfolio preparation:

Section 3B: Correlation of database records with FE data:

Since this is a junior-level course, FE data applicable to this particular instance is not available yet. For 1999 to 2005, the areas of the FE which are directly related to this course are presented in the charts shown in Figure 2. In the computer hardware category our program lost track significantly with the national results, in 2001, but surpassed the national in 2002 and came back into line in 2003. In digital systems, our program started significantly below the national average, climbed to within 5 points of the national average in 2001 and started to track the national and state averages in 2003. This course was first conducted in the fall of 2001 and therefore, its effects on the FE scores were not noticed until at least 2002. The course seems to have a continuing positive impact on the scores.





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