
AC 2012-4360: IMPROVING UPON BEST PRACTICES: FCAR 2.0

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Improving upon Best Practices: FCAR 2.0

Abstract

The Faculty Course Assessment Report (FCAR) presents a streamlined methodology that allows instructors to write assessment reports in a concise, standardized format conducive for use in both course and student (program) outcomes assessment. The FCAR is a short one to two page form completed by the instructor that taught the class. The FCAR is structured as a sequence of standardized reporting categories that include what course modifications were made, the outcomes assessment information obtained, reflection on the part of the instructor, and suggestions for curricular improvement. Through this approach, the instructor is guided through a systematic review of the course, with the additional benefit of clearly and succinctly documenting critical portions of the “closing the loop” process. At the center of this approach is the concept of performance vectors, a 4-tuple vector that categorizes aggregate student performance on a directly measured assessment artifact. For each performance criterion to be reported, an entry is placed into the FCAR documenting the criterion, the outcome being supported, the assignment(s) used for acquiring the data, the assessment tool used for evaluating the data, and the resultant performance vector. Additionally, as this assessment information is processed by the instructor who is closest to the data, any observed difficulties or extenuating circumstances affecting performance can be readily documented as part of the FCAR. For the department chair or assessment coordinator, FCARs provide a valuable resource, as all assessment information regarding a particular course is included in one place in a readily-accessible common format. This information can then be extracted and summarized in a way that allows all courses that cover a given ABET Student Outcome to be easily evaluated.

For the past several years, presentations featuring the FCAR assessment methodology have been given at the annual ABET Symposium. Based partly on this dissemination stream, the use of this instrument has spread far beyond its origins. As other institutions and departments have adopted the instrument, they have made modifications as well. In turn, these adopters have reported at a variety of venues regarding how their version of the FCAR has played a highly useful role in streamlining their continuous quality improvement processes, yielding both qualitative and quantitative information, facilitating greater consistency in the reporting and processing of that information, and keeping faculty actively engaged in an on-going assessment process. In brief, this paper will present an in-depth discussion of the FCAR instrument, how it has been adopted and modified by other programs and institutions, and recommendations regarding its future use.

1. Origins of the Faculty Course Assessment Report

It is often said that necessity is the mother of invention; the Faculty Course Assessment Report document was developed under such circumstances. During the 2001-2002 academic year, both the computer engineering and electrical engineering programs housed within the Electrical & Computer Engineering and Computer Science (ECCS) Department at Ohio Northern University (ONU) were preparing for an ABET accreditation visit under the then-new “EC 2000” guidelines requiring programs to adopt outcomes-based assessment processes. At that time, many programs

“proved” that they implemented such a process by collecting large amounts of data. This approach to the assessment and evaluation process resulted in too much paperwork and an inordinately high amount of stress for those involved in processing this data to determine the degree of compliance with the ABET Student Outcomes. A better methodology was needed; accordingly, the following set of principles for guiding the development and implementation of a streamlined outcomes-based assessment process for the ONU ECCS Department was developed:

1. Spread the workload as much as possible.
2. Collect no more data than is necessary.
3. Convert data into information as soon as possible.

By spreading the workload as much as possible, no one person is asked to perform a large and potentially overwhelming portion of the assessment process. Instead, all of the instructors in the program are asked to individually perform just that portion of the assessment process associated with their courses. By stating up front that the process is to collect no more data than is necessary, the faculty must consider both the importance and relevance of their courses’ contributions to the performance criteria that make up the assessment of the student outcomes. Unfortunately, sometimes the response is to justify the “singular importance” of one’s pet courses by listing all – even the most tenuous – connections between what they teach and the student outcomes. One successful method for reducing the amount of data collected is to adopt the concept of contribution threshold levels, where instructors are asked to identify only those components of their courses that either provide “strong support” (for example, consisting of at least 20% of the course’s content) or “moderate support” (between 10%-20% of content) toward a particular student outcome performance criterion. It should also be noted that if the FCAR is being used, adding a laundry list of student outcomes will increase the assessment and reporting workload.

By converting data into information as soon as possible, one minimizes information loss. Ideally, this conversion is performed by those who are closest to the data. In the assessment process, those who are closest to the data are the course instructors; accordingly, they are the ones who are most knowledgeable and therefore most capable in performing an evaluation of this data. Collectively, these principles are referred to in this paper as the FCAR methodology. The FCAR document was first used to report on the assessment of the ECCS courses offered fall 2001.

2. Contents of the Model FCAR Document

While some revisions to the format have occurred over the years, the basic structure and the assessment principles housed therein have remained the same. The current model version of the FCAR document (that is, the version presented at the annual ABET Symposium) consists of the eight sections listed below; an example FCAR using this format is presented in Appendix A. It should be noted that the following format is not carved in stone; a program can make modifications to the document as deemed necessary by the program and still be implementing the FCAR methodology. The key idea behind the structure of the FCAR is to systematically lead the instructor through a process that allows action items for curricular improvements to be proposed based on reviewing contemporaneous documentation of the events that occurred within the current offering of the course.

- a. **Header** – Provides both the subject code and course number, followed by course title. The header also lists the academic term for the FCAR, the course section if there are multiple sections being offered, and the instructor of record for the course.
- b. **Catalog description** – Gives the catalog description, including any prerequisites, under which this course was taught.
- c. **Grade distribution** – Lists the distribution of grades for the course, including withdrawals. Please note that the FCAR methodology does not promote the use of grades as a part of the student outcomes assessment process; rather, the purpose here is to have the FCAR serve as the one document where all relevant information for a particular course offering as determined by the program can be readily found, hence the inclusion of this information. Another benefit of reporting this information is that, by actively engaging in this computation, the instructor can better reflect upon the overall results of the course. At no time is any information included that would reveal the identity of individual students or their corresponding grades for the course.
- d. **Modifications made to course** – When the continuous quality improvement process is working, occasionally changes are fed back into the program, which is often referred to as “closing the loop” on the assessment process. However, without appropriate documentation, the modifications made to the content, organization, or operation of individual courses will go unrecognized. Accordingly, this is an important section as it provides contemporaneous documentation of course improvements made because of the assessment process. This section is used to list any substantive changes made for the current offering of the course and cites, as appropriate, the source of the improvement (e.g., recommendations from a previous FCAR document, an action plan for addressing observed shortcomings, or minutes of a committee meeting). These documented references are valuable as they allow for each modification to be traced back to its source, thereby providing proof of their systematic utilization as input to the continuous improvement process as called for by ABET Criterion 4. By combining this information with the relevant portions of the referenced items, one can easily demonstrate how the assessment and evaluation process was both started and closed for any particular modification.
- e. **Course outcomes assessment** – All course outcomes are listed and addressed separately in this section. Appropriate documentation stating what assignments were used for the assessment and the results of that assessment must be provided. If a course outcome is being used in support of a particular student outcome performance criterion, an appropriate reference to that criterion is included. Each reported course outcome must provide numerical data indicating the degree to which that outcome is being achieved. If a program is utilizing a multi-year approach to assessment, where the assessment workload is further reduced by periodically reporting data for only a subset of the course outcomes each year, then it is sufficient for those outcomes outside of that year’s reporting subset to simply mention the following two items: when the data was last reported and the next time that the reporting will occur.

An examination of how FCARs have been implemented at other institutions shows that this particular section is the one exhibiting the greatest amount of variation. While there are still some programs that follow the original approach (to be mentioned in detail later) of separately listing each component reported in support of student outcome performance criteria, most of the variations fall into two primary categories. One approach is to separate the outcomes into those that are explicitly reporting performance criteria data in support of the student outcomes and those that are not, with each being placed in its own section. This approach does have the benefit of encapsulating all information with respect to student outcomes in one location. The second approach is to only provide assessment information in support of the student outcome performance criteria, which does further streamline the reporting process, but at the possible expense of not systematically assessing the other course outcomes.

- f. **Student feedback** – When performing assessment, input should be obtained from all of the affected constituents; accordingly, it is appropriate to incorporate student feedback into the Report, if it can be obtained in a timely fashion. For those institutions that either do not engage in soliciting student feedback via course surveys, or for those who do but must wait in terms of months to obtain this feedback, then this FCAR section can be eliminated; while this information is of value, it is not critical to the assessment and evaluation process. This section is used to provide a synopsis of the student course evaluation feedback as it relates to the course; it should not merely be an exercise in cutting and pasting. While some of the comments received from students are of dubious quality, or are of constructive criticism toward the instructor, there are other comments regarding course content and organization that are worthy of being shared. This section of the FCAR allows an instructor to publicly document and share constructive comments concerning the course. By sharing this information, the student comments regarding the course now reach a wider audience, increasing the likelihood that these comments will find their way into an action plan for improving course or curricular content.
- g. **Reflection** – The primary purpose of this section is to promote self-awareness on the part of the instructor with respect to the just-completed course. Given that the goal of assessment is to improve the program, it is imperative on the part of the instructor to keep an open mind while looking at assessment results so that shortcomings can be identified and corrected. The reflection section also provides the instructor the opportunity to document impressions regarding the effectiveness of instruction, acknowledging extenuating circumstances that might have affected student performance, and provide information regarding items currently not present in the current set of course outcomes.
- h. **Proposed action items** – The specification of proposed actions items for either course or curricular improvement begins the “closing the loop” process, as these items constitute the result of the instructor’s evaluation of the course. There are no restrictions as to what can be proposed; it could be as simple as a note to include material on a certain subject in an assignment the next time it is used, or as large as a recommendation to the curriculum committee to create a new course to better deal with some of the subject material. Whatever suggestions are recorded by the instructor, it is essential that the appropriate

parties in the department review these suggestions; to that end, programs needs to somehow incorporate the review of FCARs into the overall assessment process as a regularly scheduled activity.

3. Expectations Regarding Faculty Use

The Faculty Course Assessment Report is not a magic bullet; it is just an effective reporting tool that collects all relevant information regarding a course into a single document. Any assessment methodology implemented across all courses within a curriculum will require some additional work to be contributed by each individual instructor; however, such an approach also delivers the benefit of directly involving those instructors in the continuous improvement process. As a consequence, instructors are engaged as active participants in a bottom-up approach to outcomes assessment, which also serves to improve acceptance of the assessment process. However, in order for faculty to be effective participants, some training is required as to how the FCAR document is to be used and how assessment for incorporation into that document is to be performed. Specifically, faculty are asked to directly contribute to the assessment of student outcomes by collecting evidence, usually the scores recorded from a set of one or more course assignments, processing that raw data into concise and useful information, and then using the FCAR document to report the results in support of a set of predetermined ABET student outcome performance criteria for that course.

In order to avoid a babel of different reporting formats, any program has to adopt, and therefore train the faculty to use, a single standardized format. The FCAR methodology as implemented by the ONU ECCS Department uses the “performance vector”, conceptually based upon a performance assessment scoring rubric developed by Miller and Olds¹, to categorize aggregate student performance. For conciseness, the data, in terms of the number of students falling into each category, is reported in a 4-tuple vector format containing, in order, the following fields: Excellent, Adequate, Minimal, and Unsatisfactory. This is often referred to as the EAMU vector based on the acronym generated by the first letter of each performance criterion level category. The general description of what these categories infer is in Table 1.

Table 1: The EAMU Vector Categories

Category	General Description
Excellent	Student applies knowledge with virtually no conceptual or procedural errors
Adequate	Student applies knowledge with no significant conceptual errors and only minor procedural errors.
Minimal	Student applies knowledge with occasional conceptual and/or procedural errors.
Unsatisfactory	Student makes significant conceptual and/or procedural errors when applying knowledge.

Within a course, the specification of the performance criteria that correlate to these categories is up to the instructor; accordingly, the description for each category should be developed to apply

to the specifics for the assignments used for assessment. This is often, but not necessarily, done through use of either rubrics² or by specifying scoring levels for each category, typically defined by 90% and above being considered excellent, 75%-89% adequate, 60%-74% minimal, and below 60% unsatisfactory. Ideally, the performance vectors are reported only from required courses within the curriculum and are constructed with data from only those students who received a passing grade in the course, as one of the primary questions is whether students are graduating without achieving the specified ABET student outcomes.

To avoid confusion, a point of clarification is offered: that what is being requested for in assessment is a reporting of scores, not grades, and that there is a major distinction between what constitutes a “grade” and a “score”. A “grade” constitutes a summative assessment of a student’s aggregate performance within the context and confines of a particular course. As pointed out by Rogers³, this letter grade represents the extent to which that student has successfully met the instructor’s course requirements and is subsequently reported on that student’s academic transcript. Accordingly, this grade, *per se*, does not present sufficient evidence of a direct linkage between acquired student knowledge and specific course- or program-level student outcomes. In contrast, a “score” constitutes a formative assessment of an assignment completed and submitted during the tenure of a course. This numeric score, if it can be directly linked to a specific performance criterion, can be used as evidence in support of any outcomes-based assessment process. As stated by Hatfield⁴, “virtually any assignment can potentially be used to assess student achievement of the program outcomes.” The major stipulations are that the work contained in the assignment must be reasonably tied to one or more student outcomes, and that the assessment of the assignment is conducted such that the data specific to a particular student outcome performance criterion is separated from that of other performance criteria. For example, if a particular assignment supports two performance criteria, the scoring of the assignment can be performed such that partial scores can be reported separately for each criterion.

4. Initial results, dissemination and subsequent changes

The FCAR methodology, as implemented by the ECCS Department at ONU, was and continues to be a success. Via this approach, the evidence in support of the achievement of the ABET student outcomes was collected with minimal effort. The evaluations were incorporated into the Self-Study reports for both the computer engineering and electrical engineering programs that were submitted in June 2002. The subsequent site visit went very well, with the systematic use of the FCAR document referred to as a strength of the program, and encouragement given by the visiting ABET program evaluators to disseminate this approach to the assessment community.

When first presented in April 2003 at the Best Assessment Processes V Symposium⁵ and subsequently in October at the Frontiers in Education Conference⁶, the structure of the FCAR document was slightly different than that presented here, as that version separated the information reported in support of the student outcomes from the remainder of the course outcomes. Called “components”, the intent was to draw attention to this information both to make it a focus of attention and to make this information more readily stand out for ease of extracting information. An example of an FCAR using components, which is the format still employed by the ONU ECCS Department, is presented in Appendix B. Unfortunately, this approach had the unwanted side effect of making these component elements appear to be

required portions of the FCAR document, regardless of whether or not the course in question addressed this material. In particular, in a study of FCARs retrieved via an internet search, it was observed in several cases the example FCAR document presented at the two aforementioned venues was copied verbatim, including the Ethics and Communications Components. Although the given conference presentations stated that components were to be included only when there was something to report, these programs would mention these components, then state that these components did not apply to the course; it is also possible that some components that should have been reported might not have been because that component was not present in the example FCAR document. To remedy this misinterpretation, the “components” element was removed from the model document shown in Appendix A; instead, all measures performed in the course are considered to be course outcomes. If a particular course outcome is being implemented in support of a student outcome performance criterion, then that support is now documented as part of the course outcome specification.

In 2007, the FCAR methodology was used as the basis for a heuristic approach towards student outcomes assessment. As mentioned earlier, performance vectors are used to transform the data collected from classroom-based direct assessment activities into succinct units of information that categorize aggregate student performance into excellent, adequate, marginal, and unacceptable levels. These vectors, reported via submitted FCAR documents, are processed into performance vector tables (PVT) for each performance criterion developed in support of the student outcomes. Two levels of heuristics are then used. First, for the lower-level heuristic, each performance vector in a PVT is placed into one of four possible “flag” categories, with the rationalization behind this classification schema being the desire to streamline the assessment and evaluation processes by devising mechanisms that focus attention on those areas that are out of the ordinary. Accordingly, those vectors that show acceptable levels of performance are not flagged as they do not require further review. The red and yellow flags are used to indicate the degree to which a performance vector is not meeting expectations. The red flag indicates a definite problem area whereas a yellow flag is used to indicate a potential problem area. Through this particular classification, evaluators are presented with appropriate leeway in determining whether the situation rises to the level of a problem that requires correction. The green flag is used to show when students are performing at a high level of achievement; this can be indicative of not being sufficiently challenged by the assignments involved with the assessment or of a faculty member who is unclear about the basic concepts behind the continuous improvement process. The second, upper-level heuristic is used to examine the classifications of the performance vectors in the PVT and thereby provide an overall evaluation of the degree to which the expectations for that particular performance criterion are being achieved. This evaluation is rated into one of three possible categories. In the system employed by the ONU ECCS department, the results are “Below Expectations” when there any red or yellow flags are raised in the final year of data, or if multiple red flags are raised prior to the final year of data, or if a majority of red and yellow flags are raised prior to the final year of data. The results are considered to be “Exceeding Expectations” when there are a majority of green flags raised. Finally, the results are considered to be “Meeting Expectations” when the application of the heuristic rules does not fall into either of the above two categories. The rationalization behind the upper-level heuristic is the concept that the students are being enabled by the program’s curriculum to achieve the ABET student outcomes by the time of graduation; the program can tolerate some poor performance early in the curriculum if improvement is shown later on. If a

student outcome performance criterion is meeting expectations, then no further evaluation is required. If the criterion is below expectations, a discussion is held by the members of the evaluation team to determine the source of the shortcoming, from which an action for addressing the shortcoming is specified. As part of this discussion, the FCAR documents associated with the flagged performance vectors can be examined for details regarding the assignment(s) associated with the performance vector, reflective comments made by the instructor, and any relevant suggestions for curricular improvement. If the criterion is exceeding expectations, then the evaluation team has the option of recommending that the standards be raised or that fewer courses are needed for that particular assessment. The FCAR-based heuristic approach toward student outcomes assessment was first presented in 2008 at the Best Assessment Processes X Symposium and has been presented annually at the ABET Symposium since then.

5. Expansion and modification in the ONU Mechanical Engineering Department

Context and motivation

The Mechanical Engineering Department at Ohio Northern University had been using only indirect measures of Course Outcomes for a previous accreditation visit. ABET strongly encourages the use of direct assessment techniques for monitoring the degree to which a program achieves the outcomes. Consider, for instance, the following from ABET web site related to the Best Assessment Processes Symposium: “The use of direct measures of student learning is increasingly important as programs are seeking to produce valid evidence of student learning at the program level.”⁷ A variety of means for assessing engineering education⁸ and specific courses⁹ have been published. The Department made early attempts to create a new assessment system with direct measures. Unfortunately, these systems were complicated and confusing, which made it difficult for faculty to complete the course assessments. Before the start of the 2006-2007 academic year, several faculty¹⁰ worked to implement a new system based on the FCAR. In addition to the use of the FCAR, a course Assessment Plan was written by one of the authors. This plan gave a detailed, comprehensive description of what faculty need to do to complete the assessment process in their courses. The plan also includes samples of all of the required documents.

Implementation and modifications

While the basic concept of the FCAR remained similar, several changes were made to the format. The header, catalog description, grade distribution, and course modification sections are unchanged. Due to the continuous improvement processes of the department, each course will have some changes made each year. Next comes the “meat” of the form, which relates information about the specific assessment tools used for each course outcome. This is where the majority of changes have been made. A given assessment tool (for example, a specific question on a final exam) is described, and student performance is broken into an EAMU vector. As with the original FCAR, this vector shows the number of students who performed Excellent, Adequate, Minimal, or Unacceptable work. It is worth noting that the level of performance constituting each category can vary from course to course, or even from tool to tool. Next, each tool is related to a course outcome, a student outcome, and ABET criterion, and a description of

the type of assessment tool. As an example, CO1-PO2-b-EX would indicate that the assessment tool supported Course Outcome 1, Student Outcome 2, ABET criterion b, and the tool was an Exam question. Finally, the average student self-assessment of their achievement of each course outcome was included. Three additional sections complete the form. First, a summary of student feedback (this could be from surveys, discussion, or teacher evaluation forms), followed by faculty reflection about the course and student achievement. The form closes with a concrete list of proposed actions for the following year. These could include changes to the course or the assessment methodology.

Two other changes are worth noting relative to the original FCAR, both of which were made based on feedback during the first year of implementation. First, the EAMU and Course Outcome results have been changed to a tabular format. This makes the form both easier to read and for faculty to complete. Just as importantly, this makes the form more useful for end-of-year department-level reporting. The second change (seen just below the table) is the indication of whether the numbers presented in the table are acceptable. The format shows the department standards for both student self-assessment of their learning (minimum standard of 3.0 average), and EAMU measurements (Fifteen percent or less of the results must be unacceptable on at least one assessment tool for a given course outcome). The current, updated FCAR is shown in Appendix C, completed for a course in the fall quarter.

The form was used throughout the 2006-2007 academic year. As faculty used the form, several things became apparent. First and foremost, the FCAR was an effective and relatively simple way to complete direct measures assessment of course and program outcome achievement. It also provided a good way to centralize all assessment, reflection, and changes in a given course. Finally, it provided a strong basis for assessment reporting, as will be discussed later.

It should be noted that all FCARs are reviewed at department meetings. Faculty members summarize the results of their courses. Other faculty then comment on the findings, suggest additional changes and improvements, or provide other feedback. This feedback is then added to the FCAR before the form is filed.

Additional Department-level use

At ONU, annual department assessment reports must be completed and submitted to the Office of Academic Affairs. Data from the FCARs greatly simplified this process, and provided a depth of information previously not available. The measurements from all courses were combined using Excel. By sorting these by student outcome, student achievement of student outcomes could be shown. This information was then combined with non-course measures (FE exam results, surveys, etc.) to strengthen the case for the achievement of these outcomes.

Two things became apparent when completing this report for the first time using FCARs. First, some program outcomes were not being adequately assessed (perhaps only one time in one course throughout the year). Secondly, not all faculty were assessing all of their outcomes properly in each course. This has led to some valuable review of which courses relate to which student outcomes. In addition, the Department Chair will review the FCARs after each term to

be sure that all outcomes have been properly assessed. It is felt that these two changes strengthened the department, and aided us during our accreditation visit.

Assessment Plan

An integral part of the changes in assessment procedures within the department has been the writing and maintenance of an assessment plan (available from the authors upon request). This plan is particularly helpful for new or part-time faculty, who in the past have struggled to properly assess and document their courses. In addition to instructions on how to complete the FCAR, the assessment plan includes details on the following:

- **Course syllabi:** This describes what should be included on each course syllabus. Course Outcomes are one of the items to be included on course syllabi.
- **Course Specification Sheets:** These sheets, not necessarily distributed to the students, include the course catalog description, topics, and the relationship between course outcomes and student outcomes.
- **Student Evaluation of Course Outcomes:** This shows the standard format used to collect student self-assessment of course outcome learning.

The majority of the document, however, describes the FCAR and how to collect the needed data to complete the form.

The Mechanical Engineering Department at ONU successfully made the transition to using direct measures of student achievement of course outcomes. Central to the success of this transition were the writing of a Course Assessment Plan, and particularly the use of the Faculty Course Assessment Report as described at the Best Assessment Processes Symposium¹¹. While maintaining the philosophy behind the methodology, the FCAR document was successfully modified in order to better achieve the goals of the department.

6. Expansion and adoption at Gannon University

Context and Motivation

In 2001, the Electrical and Computer Engineering (ECE) department of Gannon University began using embedded course assessment as part of the planning-learning-evaluation process to (1) teach topics aligned with the student outcomes, (2) ensure the right level of challenge, (3) focus teaching based on the teaching needs of each student, and (4) implement instructional strategies to increase student achievement. The FCAR document was adopted as the toolset for the evaluation portion of the process in 2003 to provide a workable framework for individual faculty members to follow in order to achieve uniform data collection and relevant information presentation.

From 2001 to 2005, the department devised a process for mapping course outcomes to the student outcomes that leads to defining the minimum passing criteria grading policy. The point was to ensure that upon passing a class, all students can be assured of (at least minimally) meeting the course outcomes. The result of this process is that once faculty members establish

the minimum criteria necessary to ensure that all students passing a course indeed meet the stated course outcomes. The program can safely assure the validity and effectiveness of the correlation between the student outcomes and the program educational objectives. As a byproduct of the minimum passing criteria process, faculty members are immediately provided with straightforward method for determining useful objective evidence in support of meeting course outcomes. With this minimum passing criteria process, the ECE department received a clean-bill-of-health accreditation in 2005¹². The process involves identifying student outcomes, correlating course outcomes, identifying key assignments, justifying the minimum passing criteria for key assignments, documenting objective evidence, and using the FCAR for systematic reporting. By implementing minimum passing criteria for key assignments, and properly mapping course outcomes with student outcomes, the department was able to systematically justify that all successful graduates will meet the student outcomes upon graduation. This process has resulted in significant improvements to both curriculum content and teaching methodology. Although this process has served the department well, it requires substantial effort from the faculty who monitor students closely to ensure that they are meeting the minimum passing criteria for key assignments.

In an effort to streamline the process, in 2009 the department decided to experiment with the aforementioned heuristic rules-based approach that was presented at the ABET Best Assessment Symposium¹³. This approach uses a performance vector that classifies student learning performance into four categories: Excellent (E), Adequate (A), Minimal (M), and Unsatisfactory (U), which form the EAMU performance vector. The results are flagged with different colors according to heuristic rules which indicate academic status. The performance vectors are collected from a matrix of selected courses for particular student outcomes; the resulting performance vector table illustrates the areas of strength, weakness, and concern. However, the efficacy of this rules-based approach during program evaluation relies on well-justified key assignments that form the performance vectors. In the first internal program evaluation using the rules-based approach, it was quickly realized that the inconsistency of language used by instructors to justify key assignments, as well as the composition of relevant key assignments, significantly impacted the efficiency of the evaluation process. In order to provide consistent language when justifying key assignments and the right composition of relevant key assignments, the department successfully merged the two approaches.

Implementation and Modifications

The current format of a Gannon FCAR contains the following sections:

- a) Header Information
- b) Course Description
- c) Course Outcomes Self-Evaluation
- d) Grade Distribution
- e) Relationship to Student Outcomes/Course Outcomes and Objective Evidence
- f) Old Action Items
- g) Reflection on Course Delivery
- h) New Action Items
- i) Course Outcomes Assessment
- j) Student Outcomes Assessment

Please see Appendix D for a sample of this version of an FCAR document. The main things to notice about the Gannon FCAR are how it is implemented and how it is tied to the planning and learning processes.

Planning: Criteria Mapping Process

The goals for meaningful embedded course assessment are to achieve the four points mentioned earlier. For any given course, the process of achieving these goals always involves planning for the course, conducting teaching and learning, and evaluating the effectiveness of teaching and learning. The effectiveness of each individual embedded course assessment will later impact the overall effectiveness of program evaluation. The following steps for formulating a consistent syllabus that includes all of the key elements for effective embedded course assessment which forms a major part of the teaching/learning planning process are followed¹⁴:

- Step 1 - define course outcomes: Faculty list the previously identified course outcomes. Since these course outcomes were already approved by the department, no additional work was necessary.
- Step 2 - define ABET criteria satisfied and map course outcomes accordingly: Faculty members identify the student outcomes (ABET criteria and departmental competencies) satisfied by this course and the correlation to the course outcomes. For example, course outcome 2 in the sample FCAR (Gain basic programming techniques for solution of an engineering problem) was mapped to ABET Student Outcome 3k (ability to use techniques, skills, and modern engineering tools necessary for engineering practice).
- Step 3 – understand judging/grading criteria in meeting outcomes: Faculty must understand the judging/grading criteria for this particular course outcome. In this case, in order to satisfy course outcome 2, the grading criteria must have a component measuring the ability to use techniques, skills, and/or modern engineering tools.
- Step 4 – examine all assignments and identify key assignments: Faculty members list the planned (typically major) assignments in the course and identify key assignments that support each course outcome. Justification for picking a particular set of assignments is explained in Step 5 of the criteria mapping process. Faculty are free to pick as few or as many key assignments as they wish as long as they are properly justified, as this is a key item of review for the syllabus.
- Step 5 – define justifiable key assignments: The justification must include (a) a brief description of the key assignment, (b) reasons why this key assignment is selected to support the outcome at hand, meaning the description must include language that refers back to the outcome, and (c) concluding remarks on how to use this assignment as a gauge to meet the corresponding student outcome(s).
- Step 6 – finalize the objective evidence in meeting course outcomes: Faculty members summarize the objective evidence needed for documenting the effectiveness of the class. By following this process, it is very clear what objective evidence needs to be collected at the end of the semester for each course as well as the justification for the objective evidence.
- Step 7 – rework the syllabus: The syllabus is reviewed with the department faculty.

Step 5 is where the major change from the previous process was made; previously a passing grade in assessing the success in meeting the criteria was used for the class. Since the EAMU performance vector is now used, it is not as important to place restrictions on gauging students in meeting the outcomes. It is more important to justify why the assignment was selected to gauge students' learning in order to better improve the teaching/learning dynamic. It should be pointed out that it is not necessary for the three points to be arranged as three distinct groups as long as the information is clear and the justification complete. Figure 1 shows an example of how Step 5 (streamlining the justification language) is provided for a key assignment.

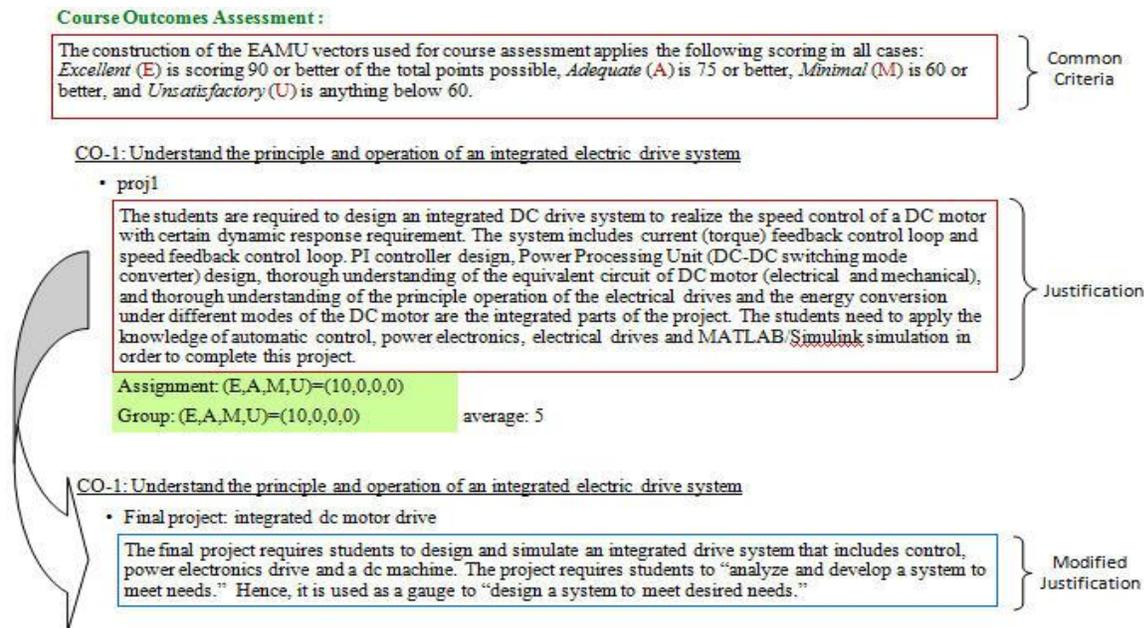


Figure 1. Justification of Course Outcomes.

Learning: Building the Electronic Course Portfolio

As part of the assessment process, each faculty member is responsible for producing a course portfolio. The course portfolio contains students' key assignments as a means to directly assess their attainment of course outcomes which in turn correlate to student outcomes. In the past, each faculty member was required to submit an objective evidence folder at the end of each semester that contained key assignments, the syllabus, and FCAR to be used at the yearly review. Gannon's ECE Department uses EvalTools®¹⁵ – an online program assessment toolset – that replaces the functionality of Blackboard® for daily classroom lesson and assignment activities; additionally, it tracks key assignments which are automatically ported into the appropriate FCAR document for evaluation purposes. The computation and tabulation of EAMU performance vectors are embedded in EvalTools®. Once a key assignment is graded, the scores are submitted to EvalTools®. EvalTools® then produces the necessary EAMU vectors for each key assignment and their mapping to either the course outcome or the student outcome in the relevant FCAR. EvalTools® also provides the necessary objective evidence folders electronically at the end of

the semester. As a result, the faculty workload is lessened, allowing faculty members to focus on teaching and their usual daily activities.

Thus far, the ECE department has used EvalTools® to achieve the following:

- Lessons – a depository for lessons and lectures
- Assignments – tracking of assignments in meeting course objectives
- Grade book – maintaining course grades
- FCAR – Faculty Course Assessment Report
- Course syllabus – systematically documenting learning activities
- Rubric – easy creation of rubric for consistent gauging of meeting outcomes
- Objective evidence folder – a centralized depository for all artifacts collected in class
- Course exit survey – tracking end-of-semester course survey in meeting course outcomes
- Senior-exit survey, alumni survey, employer survey – customizable surveys to suit this university’s needs
- Curriculum outcomes matrix – facilitating easy review of program strengths and weaknesses
- Trend-analysis course matrix – giving longitudinal perspective on course performance
- Action items matrix – systematically documenting action items for closure and improvement
- Student outcomes evaluation – tracking and reporting the review and results on PVT
- Executive summary on Student outcomes – tracking and reporting the review and results on evaluation

The FCAR displays the EAMU criteria to remind the evaluation team of the percentage of scores for the EAMU vector. If a faculty member decides to individually set a different set of performance criteria percentages for the EAMU vector, EvalTools® facilitates the individual setting as well. During the evaluation process, first the course outcome language as it is indicated is read, and then the key assignment selected and its corresponding justification is examined. The following questions are then addressed:

- Is the key assignment relevant to the outcome that it intends to satisfy?
- Is the key assignment being graded according to the skill sets or student outcomes that it intends to provide?

Indirect assessment is also used as a complimentary input for course outcomes assessment, including student-based qualitative input. In order to achieve appropriate validity for assessment data based on student’s opinions valid, faculty self-assessment is used, thereby compartmentalizing valid student inputs to both inform and drive additional inputs for improvement. Hence, the section of “Course Outcomes Self-Evaluation” was added into the FCAR.

It can be reported that Gannon’s ECE department achieved ABET reaccreditation using the FCAR methodology. The program evaluators consistently cited the systematic approach using EvalTools® with embedded FCARs as one of the strengths of the department both in 2005 and

again during the most recent visit in 2011. A final decision on accreditation will be made in July 2012.

7. Moving to FCARs at Southern Polytechnic State University

Context and Motivation

In 2003, the Computer Science (CS) department at Southern Polytechnic State University (SPSU) made a decision to pursue ABET accreditation for its program. The faculty knew that assessment would be a large part of the process. The department chair and faculty lead for the accreditation efforts began to search for available tools, mechanisms, and processes to facilitate the assessment of both courses and the program. The department chair attended the 2004 Best Assessment Processes Symposium and returned the concept of the Faculty Course Assessment Report as introduced by Estell⁵. After reviewing the document and associated process, it was decided to be an ideal mechanism for recording assessment efforts.

After initial usage of the FCAR methodology, SPSU found that some adjustments to the original FCAR format were needed for internal purposes. Both the course and program outcomes were kept because computer science is accredited under the Computing Accreditation Commission (CAC) rather than the Engineering Accreditation Commission (EAC) and the requirements, while similar, are also slightly different. Under the CAC programs are required to measure both Program Educational Outcomes (PEOs) as well as Student Outcomes (SOs). CAC programs are not required to measure student attributes (“a-k” criteria) as programs under EAC are. Therefore, for programs going for accreditation under CAC it is important to have places for course outcomes, program outcomes, and student outcomes. The SPSU version of the FCAR does this.

Implementation and Modifications

The FCAR, as adopted by the CS department, provides a format that allows course assessment reports to be easily used as part of assessing program outcomes as well as course outcomes. The FCAR process requires a small amount of additional work on the instructor’s part at the beginning and end of the term. It also allows those closest to the data to analyze it and transform it into useful information for later evaluation. The key for SPSU faculty adoption was the concept of “spreading the workload” amongst all the faculty rather than concentrating it on one or two individuals. Each faculty member is responsible for the classes they are teaching and thereby provide a single FCAR for each course. At the beginning of the semester the instructor begins their FCAR at the same time they are constructing their syllabus for the class. They complete the first several sections of the FCAR and begin to think about modifications that should be made to the course. At this time they can review previous FCARs for the course as well. During the term instructors record assessment data for student performance on the course and program outcomes. At the end of the term faculty members complete their FCARs and submit them by the fourth week of the next term.

The current format of an SPSU FCAR, as can be seen in Appendix E is:

- a) Header Information – this contains the name of the file (based on adopted naming conventions to allow previous FCARs to be found easily), the course number, course title, section information, number of credit hours, year and term, and instructor name
- b) Catalog Description – description of the course pulled from the current catalog
- c) Student Outcomes for the course – a list of faculty approved student outcomes for this specific course. All course outcomes are stored on a central web page for easy access by faculty members.
- d) Student Outcomes for the program – certain courses also measure program outcomes. These courses and related outcomes are also stored on the central web page. Faculty members need only access a single web page¹⁶ to find all outcomes, both course and program, that must be measured for a single course.
- e) Modifications made to the course – a list of any changes made to the course for the current instantiation. Faculty members must identify the source (or reason) for the change. This can be previous FCARs, student feedback, Industrial Advisory Board input, or other recognized source.
- f) Textbook Used – faculty members must identify the resources used in teaching the class.
- g) Grade Distribution – a distribution of the final grades within the course. In addition, a success rate for the course is also calculated.
- h) Assessment for Student Outcomes for the course – for each student outcome listed in 3, the instructor must identify the source for measuring student achievement for that outcome. This may be test questions, assignments, lab exercises, or any assessed artifact within the course. The outcome may be measured using multiple assessments, in which case the assessments are averaged. Results are reported for all students that successfully pass the course with an A, B, or C. Each student is rated for each course outcome using the following scale:
 - i. Excellent (3) – indicating the student performed at a 90% or better rate
 - ii. Effective (2) – the student performed at least at a 75% rate
 - iii. Minimal (1) – the student performed at least at a 60% rate
 - iv. Unsatisfactory (0) – the student performed below at 60% rate

(An overall average of student performance is calculated as well.)
- i) Assessment for Student Outcomes for the program – for each program outcome listed in 4, the instructor must identify the source for measuring student achievement for that outcome. This may be the assessments used in the course outcomes, a combination of course outcome assessments, or something else. Results are reported for all students that successfully pass the course with an A, B, or C. Each student is rated for each course outcome using the following scale:
 - i. Exemplary (3) – indicating the student performed at a 90% or better rate
 - ii. Proficient (2) – the student performed at least at a 75% rate
 - iii. Apprentice (1) – the student performed at least at a 60% rate
 - iv. Novice (0) – the student performed below at 60% rate

(An overall average of student performance is calculated as well.)
- j) Reflection – a place where the instructor may reflect on the overall success or specific instantiation of a course. If any of the course or program outcomes were not met, a discussion of suspected reasons should be included.
- k) Proposed Actions for course improvement – a list of ideas to be considered the next time the course is taught.

- l) Other Notes – any additional information relevant to the course report.
- m) Assessment Instruments – instructors must attach all sources for course and program assessments listed in the course and program outcome sections.

There are several important things to notice about the SPSU FCAR and our process. Faculty developed all the course and program outcomes as well as the mapping of which courses measure program outcomes. These course outcomes and the mappings are reviewed each fall at the undergraduate assessment retreat to ensure they are being measured, are measured appropriately, and that the course is still the appropriate place to measure the program outcome. Several courses measure program outcomes for more than one program (e.g., Computer Science and Software Engineering). This required the creation and maintenance of a single web page¹⁶ to list all outcomes for every program and to map them to specific courses. This allows instructors to visit a single website for their course to collect all the information needed.

Because many SPSU faculty have adopted online resources in addition to, or as replacement of, textbooks, the instructor is now required to list all the resources available to the student, allowing for the comparison of results after a textbook change. Within the grade distribution section faculty members must also calculate a success rate for the course. With increased attention on retention, progression, and graduation of students, having awareness of the numerical success rate of a course has allowed the program to focus attention and resources on courses with low success rates. Course and program outcome assessments are only reported for students who pass the class with a grade of either an A, B, or C. Students who complete the course with a D or F must retake the course to complete the major, and thus, have definitely not achieved the outcomes being measured. The assessment numbers are used to represent the desired capabilities of the program's graduating students, with all students that pass a course to be performing at either an Effective or Proficient level. For all program outcomes, the expected performance criterion level is a class average of 2.0 (Proficient) or higher. Course outcomes for freshman and sophomore classes should be at least 1.0 (Minimal) whereas outcomes for junior and senior level classes should be 2.0 (Effective) or above. Finally, faculty now attach the assessment instruments directly to the FCAR to facilitate review of the assessment sources during the undergraduate assessment retreat. One section that was removed was the Student Feedback section. As results from student surveys are not normally received until four to five weeks into the next term, the information was not available when FCARs were due.

Using the FCAR to measure course and program assessment has been very well received at SPSU. While faculty do sometimes complain about the additional work required in tracking results of individual test questions related to outcomes, the value of the data collected and analyzed has proven to outweigh any negativity associated with the extra effort. Having evidence that students were doing poorly in certain course outcomes led to direct changes within the curriculum earlier in the sequence to improve student achievement. Illustrating to faculty that students perform better when a certain textbook is used in a class has resulted in faculty members adopting the new textbook.

The process was so successful that the concept of the FCAR has spread beyond just the computer science program. First it was adopted by the other programs within the School of Computing and Software Engineering: Information Technology, Software Engineering, and Computer Game Design and Development. Then the Engineering Technology departments and

Engineering School asked for training and information as they prepared for ABET accreditation visits. Finally, as SPSU was preparing for regional accreditation by SACS (Southern Association of Colleges and Schools), it was adopted throughout the entire campus to measure the general learning outcomes for the university. Each program that adopted the FCAR has modified it slightly for their needs. This can most easily be seen in the humanities courses, which use ICAs (Individual Course Assessment), an example of which is presented in Appendix F. In an ICA there are no program outcomes to measure. For each student outcome in the course, the instructor must identify the method of assessment and the performance criterion level if other than the required 70% or better on all measures specified. Results need not be numeric and are not based on the EEMU scale. Results can be qualitatively defined if desired, but must show evidence of assessment and analysis. ICAs also maintain the original FCAR Student Feedback Section.

It can be reported that SPSU passed SACS accreditation using the FCAR and its modified versions. For ABET accreditation, both the Computer Science and Information Technology programs were both accredited on their first visits. The programs have recently undergone their second ABET accreditation visit and results for the assessment portion of the visit went well for all programs under consideration (Computer Science, Information Technology, Computer Game Design and Development, and Software Engineering). The program evaluators were complimentary concerning the assessment process and the use of FCARs to measure course and program outcomes. Note that a final decision concerning accreditation will be made in July 2012.

8. Conclusion

This paper has provided an overview of the Faculty Course Assessment Report document, beginning with its initial development over ten years ago at Ohio Northern University. Presentations on the FCAR document and its assessment methodology have been made in a variety of venues, most notably as an invited presentation at the annual ABET (formerly Best Assessment Processes) Symposium. Many who have attended these presentations have subsequently implemented the document at their institution, with some going on to write about their experiences. Three such authors have collaborated with the FCAR's originator in this paper to provide examples of the motivation for implementation of the FCAR, and shown the variety of approaches and enhancements taken. In particular, this paper detailed how the Mechanical Engineering department at ONU implemented the FCAR, modifying the format slightly, adding thresholds to the report, and using it for internal reporting as well as for ABET. The paper further details how Gannon University has implemented the FCAR with an all-electronic system, EvalTools®. Finally, the paper describes the implementation of FCARs at Southern Polytechnic State University. There, the FCARs started in the Computer Science program, but have now spread across the entire campus as part of the university's accreditation plan.

Appendix G provides a list of FCAR-related publications. From these publications, plus examples of actual FCAR documents and Self-Study documents featuring the use of FCAR, some conclusions can be drawn and commonalities identified. While the FCAR does take time to complete, it becomes easier to fill out as one becomes accustomed to the process. The FCAR allows all of the information regarding a course to be reported within a single document, thereby both streamlining and standardizing the assessment process. The FCAR provides

contemporaneous documentation of the continuous quality improvement process, including evidence of the loop being closed through specific, documented modifications made to a course via the assessment and evaluation process. Finally, the FCAR methodology is sufficiently flexible to allow programs to individualize their particular FCAR document to meet that program's specific assessment needs. By starting with the FCAR and customizing, rather than “starting from scratch”, schools typically save time, and have a proven methodology to frame their course-based assessment of student outcomes.

While each program mentioned in this paper has made modifications to make the FCAR work well within their specific institutional/departmental context, it should be noted that the core components of the FCAR have not changed. In particular, the authors feel the following items make up the critical core of the FCAR:

- a) What are the unique identifiers (course name, number, section, instructor, and description) for the specific offering of the course?
- b) What, if anything, was done to modify this course for this offering?
- c) What, if anything, was assessed, and what mechanism was used for each assessment?
- d) What are the results of the evaluation of the assessment data?
- e) What, if any, recommendations are there for furthering the improvement of the course and/or program?

Why are these items critical? Essentially, they allow interested parties (faculty teaching a course, department heads, ABET evaluators, etc.) to easily find data related to courses and to the assessment of student outcomes. It becomes simple to “track” a series of changes made to a course, and to see if there is evidence of the efficacy of those changes. Without such documentation, effectiveness of changes becomes anecdotal or nonexistent. It also allows program evaluators to clearly see that a given course outcome was in fact assessed for a given course, and the level to which that outcome was met (using the 4-tuple performance vector distribution).

It is hoped that this paper can serve as a guideline to programs which may be interested in implementing the FCAR document and methodology in their programs. As such, the Appendices show examples of completed FCARs. In addition, the authors are glad to discuss implementation with any interested parties.

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APPENDIX A: SAMPLE INITIAL FCAR

Faculty Course Assessment Report
ECCS 100 – Introduction to ECCS (sections 00 and 01) – 1.00 credit
Spring Quarter 2011 - John K. Estell

Catalog Description:

Orientation to the department. Familiarization with requirements for the majors, planning program of courses, university catalog, and library. Exposure to TLAs such as PHP, ASP, PLC, BJT, etc. Philosophical discussion of the metavariables foo and bar.

Grade Distribution:

A	B	C	D	F	W	Total
3	5	11	4	2	1	26

Modifications Made to Course:

1. Dropped lecture on introduction to computer use on campus; students found the material redundant. Source: FCAR for ECCS 100 sections 03-04 Spring Quarter 2010 by Dr. Geithmann.
2. Included lectures on professional ethics based upon the ACM and IEEE Codes of Ethics. Source: 2010 Faculty Retreat, Action Plan #4 (Ethics Across the Curriculum)
3. Included information on using OhioLink for library searches as this technology is now available.

Course Outcomes Assessment:

- CO-1. Define basic TLAs relevant to the major.
Sources: questions 10-19 on midterm exam; questions 1-10 on final exam. EAMU vector: (18, 3, 0, 2).
- CO-2. Apply the metavariables foo and bar as appropriate for various situations.
Source: metavariables quiz. EAMU vector: (5, 6, 11, 1).
- CO-3: Demonstrate knowledge of a professional Code of Ethics (**supporting Student Outcome Metric f-2**).
One lecture was dedicated to coverage of the IEEE Codes of Ethics and their role in daily professional life. A second lecture featured our Engineer-in-Residence discussing ethics in the workplace. Final exam questions 14-17 were used to test retention of this information. EAMU vector: (15, 6, 1, 1).

Student Feedback:

On the student course evaluation forms, students indicated a general dissatisfaction with the lecture on career opportunities available to our majors. Some expressed an interest in having a mentoring program to ease the transition into college life. A couple of students indicated that we should spend less time on dealing with university paperwork and more on what it is like to be an engineer.

Reflection:

Overall, the course went well, but some areas need work. Half of the class demonstrated less than effective proficiency with metavariables. The explanation of the rationale behind our common freshman core course sequences was insufficient. We should advertise the success of our alumni. The addition of the ethics lectures was well received; student enjoyed talking with a real engineer about the situations she's encountered in the workplace.

Proposed Action Items:

1. Add a panel discussion featuring alumni from each programs to discuss what they do on the job as engineers.
2. Develop new curriculum flowcharts that stress the commonality of the freshman year; use them to illustrate how students can freely change/decide their major within the department in the first year without any penalty.
3. Develop an active learning exercise featuring metavariables to provide students additional experiences with their use.

APPENDIX B: SAMPLE CURRENT ONU ECCS FCAR

Faculty Course Assessment Report
ECCS 166 – Programming 3 – 4.00 credits
Spring Quarter 2011
John K. Estell

Catalog Description:

Continuation of topics from ECCS 165 with the possible introduction of a second programming language. Usage of libraries, components, and the graphical user interface. Prerequisite: ECCS 165 (Programming 2).

Grade Distribution:

A	B	C	D	F	W	Total
4	8	2	0	0	0	14

Modifications Made to Course:

1. Used MP4 to incorporate a KEEN activity to promote the entrepreneurial mindset in the classroom by writing an educational game that assists in the achievement of the Ohio Academic Content Standards for Third Grade students. Teams of two were assigned to research two of the following seven distinct content areas: English Language Arts, Fine Arts, Foreign Language, Mathematics, Science, Social Studies, and Technology. The team had to identify a specific content area, one or more standards, and one or more associated benchmarks to be addressed through the development of a Java Web Start Application program featuring a graphical user interface. Source: Engage the Entrepreneurial Mindset Workshop, ONU, July 2010.
2. Used “Dropbox” cloud computing service to establish – at no cost to individuals or institution – sharable folders between instructor and students for purposes of electronic project submission and distribution of programming-related resources. Dropbox also allowed students to recover lost and/or corrupted files, and to establish shared folders between students for working on team-based programming assignments.
3. Number of homework assignments was increased from 9 to 15. Source: ECCS 166 Spring 2010 FCAR.
4. Biweekly quizzes were used in place of a midterm.

Course Outcomes Assessment:

The construction of the EAMU vectors used for course/program assessment applies the following metric in all cases: Excellent is scoring 90% or better of the total points possible, Adequate is from 90-75%, Minimal is from 75-60%, and Unsatisfactory is anything below 60%.

CO-1: Develop event-driven programs utilizing GUI components and containers.

All programming assignments required the use of Swing-based GUI applications featuring event-driven processing. Programming assignment MP3 used for assessment. EAMU vector (5, 9, 0, 0)

CO-2: Utilize a collections framework for the manipulation of data.

Questions 1-11 on the final exam were used to test student knowledge and comprehension of the material. EAMU vector: (1, 0, 6, 7)

CO-3: Demonstrate an understanding of the OOP paradigm as implemented in Java.

Final exam questions 25-40: EAMU vector (10, 3, 1, 0)

CO-4: Implement a class via a design-by-contract document.

MP 1: Each student had to implement five specified methods for the GuessValue class. EAMU vector: (8, 6, 0, 0)

CO-5: Demonstrate a fundamental understanding of the use of graphics in Java.

Labs 7-11 dealt specifically with implementing a graphics drawing program. EAMU vector (7, 4, 0, 3). It is noted that the three unsatisfactory marks were generated by students who did not submit at least half of these five labs.

Programming Competencies Component (CS metric 2-c-1):

Fundamental programming concepts (such as operators, declarations, and flow control) should be firmly established by the third programming course; accordingly, the first six homeworks were used to assess the students' competency level. It is noted that the one student that is in the unsatisfactory category failed to submit three of the homeworks from this set, and that the one student in the minimal category failed to submit one of the homeworks, both of which are skewing this data. EAMU vector: (10, 2, 1, 1).

Design Specifications Component (CS metric 2-c-1):

MP3 provided students with the opportunity to implement an unfamiliar board game based on only the flyer providing the rules of the game. Evaluation based on correctness of implementation. EAMU vector: (6, 4, 1, 2).

Troubleshooting Component (CPE metric 1-e-1):

Ten of the homework assignments contained "Find the Error" questions; the results from these specific questions were separately reported for those assignments, then aggregated. It is noted that the two students who received unsatisfactory scores in this area failed to submit at least three of these ten assignments. EAMU vector: (9, 3, 0, 2).

Solution-Building Tools Component (CS metric 4-i-1):

Students used the latest version (6.9.1) of the NetBeans IDE to implement all programming assignments. Assessment based on a quiz over the use of NetBeans. EAMU vector: (8, 6, 0, 0).

Student Feedback:

One student suggested that the room needs better speakers. One student suggested pairing the language with data structures. Quantitative assessment of the course was highly positive in all eight categories, with means ranging from 4.1-4.7/5.0.

Reflection:

Students are having difficulty in retaining an understanding the Collections Framework. Sound is definitely an issue; many classrooms in the College have only desktop speakers. While our room has a speaker in the projector, it's still inadequate.

Proposed Action Items:

1. Spend more time on the Collections Framework. Given the extra amount of time under semesters, recommend creating a short series of labs that expose students to the basics of List, Set, and Map, then have them implement a dictionary program (which would require at a minimum the Map and List collections to be used).
2. Recommend to the College that all classrooms be upgraded with appropriate speaker systems.

APPENDIX C: SAMPLE ONU MECHANICAL ENGINEERING FCAR

Faculty Course Assessment Report
ME 401 – Process of Mechanical Design – 3.0 credits
Fall Term 2010-11 – Dr. Yoder

Catalog Description: The process of design is covered with a focus on problem-solving methodology and project management. Teamwork tools and design are used on a team project.. Prerequisite: ME senior standing. Corequisite: ME 411. Offered Fall Quarter.

Grade Distribution:

A	B	C	D	F	W	Total
13	18	3				34

Modifications Made to Course:

1. Added speaker on LEED and Patent Law (existing speakers on communication and project management)
2. Required attendance at Career Fair

Course Outcomes: Upon completion of the course, students will be able to:

1. Describe the importance of design.
2. Describe the design process.
3. Describe specific actions to promote sustainable engineering.
4. Submit a team project based on teamwork-based tools.
5. Demonstrate proficiency with formal design tools.
6. Describe the legal and ethical responsibilities of a designer.

CO	Survey	Assessment Tool	E	A	M	U	PO	Type
1	4.12	Midterm problem #2: Describe role of design	8	5	10	11	3	EX
		Final exam, problem #6: Role of design in profit	27	2	5	0	3	EX
		Essay on faulty pumps installed in New Orleans	19	5	5	5	8	HW
2	4.21	Midterm exam #3: Steps in design process	34	0	0	0	3	EX
		Final exam #2: Steps in design process and tools in each step	26	5	3	0	3	EX
3	4.03	Midterm exam #7: Actions to promote sustainability in design	32	0	0	1	8	EX
						10	EX	
		Final exam #12: Actions to promote sustainability in design	30	3	1	0	8	EX
						10	EX	
4	4.21	Final team design project	12	22	0	0	3	PR
						4	PR	
						7	PR	
		QFD for design project	27	4	3	0	3	HW
5	3.88	Final exam #9: QFD	22	9	3	0	11	EX
		Final exam #8: Decision Theory	15	2	2	15	11	EX
		Final exam #14: Functional Decomposition	7	16	5	6	11	EX
		Final exam #15: Morphological chart	19	9	4	2	11	EX
		Final exam #16: Pugh's method	19	10	4	1	11	EX
		HW: Sensitivity	21	4	7	2	11	HW
6	3.88	Essay on faulty pumps installed in New Orleans	19	5	5	5	8	HW
						10	HW	
		Final exam #3: Liability questions	17	0	15	2	10	HW
		Midterm exam #10: Intellectual Property	29	4	0	1	10	HW

- All student responses were acceptable (3.0 or higher).
- All course outcomes are acceptable (at least one assessment tool with U≤15%)

Student Feedback:

1. Positive feedback overall.
2. Students still don't like the project.

Reflection:

1. I don't think we can do without the project.
2. Would like to get more outside speakers, may replace some.
3. Several students did not take the making of the part seriously. Students had problems getting theory to match reality.

Proposed Action for Course Improvement:

1. Continue to increase integration with Capstone.
2. Make grading scale more clear on the part.
3. Integrate engineering economy.
4. More time for project should allow more time for redesign. Perhaps I should require retest?

APPENDIX D: SAMPLE GANNON FCAR

ECE_105_01 Engineer Tools Appl

Faculty Name : **Mak, Fong K.**
 Department : **ECE**

Response Rate : **12/13**
 Term : **Fall 2009**

Co-requisites:

ECE106

Course Description:

An introduction to computer programming using Matlab. Emphasis on the logical thought process needed to solve engineering problems, and on the application of engineering principles. Students will use the computer lab to complete assignments.

Course Outcomes

Outcomes	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N.A.
1 Develop skills in using modern engineering tools for solving engineering problem						X
2 Gain basic programming techniques for solution of engineering problem						X

Grade Distribution:

Grade:	A	B+	B	C+	C	D	F
Distribution:	5	0	0	5	2	1	0

Old Action Items:

Term/Course	Action Items	Owner	Closing Date	Status
CourseExit_2008_09_17 ECE_105_01	reduce the course content in chapter 7 or to omit it totally	Mak	Fall, 2009	closed

Reflection on Course Delivery:

student behavior

- This class consists of two groups of students equally divided. One group is international students from middle east. The other is domestic students. The domestic students have gradually learned the material as expected and excelled in performance towards the second half of the semester. The international group on the other hand, felled behind in learning. Not so much as to submitting assignments, but more on learning attitude is not progressive for the international group.

subject matter

- The issue is also reflected in the EAMU vectors for course outcomes assessment. Students, in particular the international group, are having difficulty in developing skills in *for solving engineering problem*. They appear to understand the programming skills, but not the problem solving skills.

New Action Items:

Action Items	Owner	Closing Date
more smaller assignments focusing on hand calculations or work should be given in addition to lab assignments which focuses on tool usage.	Mak	Fall, 2010

Course Outcomes Assessment:

The construction of the EAMU vectors used for course assessment applies the following scoring in all cases: *Excellent (E)* is scoring 90 or better of the total points possible, *Adequate (A)* is 75 or better, *Minimal (M)* is 60 or better, and *Unsatisfactory (U)* is anything below 60.

CO-1: Develop skills in using modern engineering tools for solving engineering problem

- Exm1 - part 2:tax

This project requires the student to program an algorithm to calculate taxes for different brackets of incomes. Good design process and documentation are emphasized in the project. Successful completion of this project satisfies the objective of following a methodological design approach to identify, formulate, and solve engineering problems.

Assignment: (E,A,M,U)=(5,3,0,5)

Group: (E,A,M,U)=(5,3,0,5) average: 2.69

CO-2: Gain basic programming techniques for solution of engineering problem

- **Final Proj**

Final Project requires the student to program an algorithm using Matlab that involves the use of array, function and input and output, and plotting techniques. Successful completion of this project satisfies the objective of using modern engineering tools for solving engineering problem.

Assignment: (E,A,M,U)=(6,3,3,1)

Group: (E,A,M,U)=(6,3,3,1) average: 3.46

Overall: (E,A,M,U)=(5.5,3,1.5,3) average: 3.08

Student Outcomes Assessment:

Item	Student Outcomes	Correlated Course Outcomes	Key Assignments	E	A	M	U	Average
1	Ability to identify, formulate, and solve engineering problems	CO 1,	Exm1- part 2:tax,	5	3	0	5	2.69
2	Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	CO 2,	Final Proj,	6	3	3	1	3.46

APPENDIX E: SAMPLE SPSU FCAR

Faculty Course Assessment Report
CSE 2642 – Professional Practices and Ethics
Spring 2011 – Barbara Bernal

Catalog Description

This course covers the historical, social and economic consideration of the discipline. It includes studies of professional conduct, risks, and liabilities, and intellectual property relative to the software engineering and computing professions. Software engineering/computing case studies will be used.

Student Outcomes for the Course

Upon successful completion of this course, students will be able to:

1. Identify ethical responsibilities and considerations and apply ethics, including professional codes of ethics, in scenarios and case studies.
2. Identify and use resources for keeping up with the profession.
3. Discuss legal and ethical issues relevant to freedom of speech, intellectual property, privacy, and security.

Program Outcomes Supported:

CS Outcomes (measured)

6. Demonstrate an understanding of social, professional and ethical issues related to computing.

SWE (measured)

- f) An understanding of professional and ethical responsibility
- h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i) A recognition of the need for, and an ability to engage in life-long learning

CGDD (measured)

6. Demonstrate an understanding of social, professional, global, and ethical issues related to computing
8. Demonstrate effective oral and written communication skills

Modifications Made to Course

None.

Grade Distribution

	A	B	C	D	F	W	Total
001 Section	29	4	0	0	0	1	34
850 Section	18	7	2	2	2	3	34
900 Section	6	0	0	0	2	0	8

Overall Success Rate (without W):

001 Section 33/33 = 100 %

850 Section 27/31 = 87 %

900 Section 6/8 = 75 %

Assessment of Student Outcomes for the Course

Course Outcome 1: Identify ethical responsibilities and considerations and apply ethics, including professional codes of ethics, in scenarios and case studies.

Assessment sources: Quiz Two and Final Exam Question 2

Results of CSE 2642/001 Section:

Average = 2.42(effective); EEMU¹ vector: (18, 10, 3, 2); N = 33.

Results of CSE 2642/850 Section:

Average = 2.1(effective); EEMU vector: (15, 10, 6, 0); N = 31.

Results of CSE 2642/900 Section:

Average = 2.13(effective); EEMU vector: (5, 1, 0, 2); N = 8.

Course Outcome 2: Identify and use resources for keeping up with the profession.

Assessment sources: Final Exam Question 1, 4, 5

Results of CSE 2642/001 Section:

Average = 2.212(effective); EEMU vector: (18, 9, 6, 0); N = 33.

Results of CSE 2642/850 Section:

Average = 2.484(effective); EEMU vector: (15, 15, 1, 0); N = 31.

Results of CSE 2642/900 Section:

Average = 2.25(effective); EEMU vector: (6, 0, 2, 0); N = 8.

Course Outcome 3: Discuss legal and ethical issues relevant to freedom of speech, intellectual property, privacy, and security.

Assessment sources: Assignment 3 and the student's Leader Discussion on Topic.

¹ EEMU = Excellent, Effective, Marginal, Unsatisfactory

Results of CSE 2642/001 Section:
Average = 2.3(effective); EEMU vector: (11, 20, 2, 0); N = 33.
Results of CSE 2642/850 Section:
Average = 2.42(effective); EEMU vector: (18, 10, 3, 0); N = 31.
Results of CSE 2642/900 Section:
Average = 2.125(effective); EEMU vector: (5, 1, 1, 1); N = 8.

Assessment of Student Outcomes for the CS Program

CS Program Outcome: 6. Demonstrate an understanding of social, professional and ethical issues related to computing.

Assessment source: Midterm Question 2, 3, and 4.

Results of CSE 2642/001 Section: EPAN vector: (16, 12, 3, 2); N = 33.
Average = 2.36 (Students performed at the *proficient* level).
Results of CSE 2642/850 Section: EPAN vector: (16, 9, 6, 0); N = 31.
Average = 2.2 (Students performed at the *proficient* level).
Results of CSE 2642/900 Section: EPAN vector: (4, 1, 1, 2); N = 8.
Average = 2.5 (Students performed at the *proficient* level).

Assessment of Student Outcomes for the SWE Program

SWE Program Outcome f) An understanding of professional and ethical responsibility

Assessment source: Midterm Question 2, 3, and 4.

Results of CSE 2642/001 Section: EPAN vector: (16, 12, 3, 2); N = 33.
Average = 2.36 (Students performed at the *proficient* level);
Results of CSE 2642/850 Section: EPAN vector: (16, 9, 6, 0); N = 31.
Average = 2.2 (Students performed at the *proficient* level);
Results of CSE 2642/900 Section: EPAN vector: (4, 1, 1, 2); N = 8.
Average = 2.5 (Students performed at the *proficient* level);

SWE Program Outcome h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Assessment sources: Assignment 3 and the student's Leader Discussion on Topic.

Results of CSE 2642/001 Section: EPAN vector: (11, 20, 2, 0); N = 33.
Average = 2.3(Students performed at the *proficient* level).
Results of CSE 2642/850 Section: EPAN vector: (18, 10, 3, 0); N = 31.
Average = 2.42(Students performed at the *proficient* level).
Results of CSE 2642/900 Section: EPAN vector: (5, 1, 1, 1); N = 8.
Average = 2.125(Students performed at the *proficient* level).

SWE Program Outcome i) A recognition of the need for, and an ability to engage in life-long learning

Assessment source: Final Exam Question 1 and 4.

Results of CSE 2642/001 Section: EPAN vector: (16, 12, 2, 3); N = 33.

Average = 2.36 (Students performed at the *proficient* level).

Results of CSE 2642/850 Section: EPAN vector: (18, 10, 3, 0); N = 31.

Average = 2.42(Students performed at the *proficient* level).

Results of CSE 2642/900 Section: EPAN vector: (5, 1, 1, 1); N = 8.

Average = 2.125(Students performed at the *proficient* level).

Assessment of Student Outcomes for the CGDD Program

CGDD Program Outcome: 6. Demonstrate an understanding of social, professional and ethical issues related to computing.

Assessment source: Midterm Question 2, 3, and 4.

Results of CSE 2642/001 Section: EPAN vector: (16, 12, 3, 2); N = 33.

Average = 2.36 (Students performed at the *proficient* level).

Results of CSE 2642/850 Section: EPAN vector: (16, 9, 6, 0); N = 31.

Average = 2.2 (Students performed at the *proficient* level).

Results of CSE 2642/900 Section: EPAN vector: (4, 1, 1, 2); N = 8.

Average = 2.5 (Students performed at the *proficient* level).

CGDD Program Outcome: 8. Demonstrate effective oral and written communication skills.

Assessment source: Assignment 3 and the student's Leader Discussion on Topic.

Results of CSE 2642/001 Section: EPAN vector: (11, 20, 2, 0); N = 33.

Average = 2.3(Students performed at the *proficient* level).

Results of CSE 2642/850 Section: EPAN vector: (18, 10, 3, 0); N = 31.

Average = 2.42(Students performed at the *proficient* level).

Results of CSE 2642/900 Section: EPAN vector: (5, 1, 1, 1); N = 8.

Average = 2.125(Students performed at the *proficient* level).

Student Feedback

They commented that the topic discussions were the best part of the course.

Assignment Three Plan for your discussion topic - 25 points due Sunday, Feb. 13

1. Give the Topic Issue Number and Title that you are leader.
Give the other Leaders in this Issue.
2. Give the research you have done on the issue. Please give these research notes that you have done and maybe have in your TOPIC Journal. See samples of this in the Topic Start Link in the class web site. Please read your book and look at the Topic Info Link in the class web site. This was in Step One of the Topic Start Link.
3. Plan your topic definition or explanation.
 - a. Give your definition & explanation of your issue with the source.
 - b. How does yours differ from the other leaders?
4. Choose an ethical scenario that gives dilemmas in the topic. Give the scenario; case study; current event reporting; etc. Give the source and the date of the occurrence.

You do not need to do the Step 2 of the Topic Start Link with is the proposal for a Law in this plan. You do not need to make the powerpoint for your presentation in this plan. This is just the Plan with the research and a issue definition that you will continue to develop into your discussion.

Quiz Two CSE 2642 SPR 2011 Name _____
Please read the following and answer the questions below.

Greg is a recently hired software engineer who has been recruited directly out of college. For his first assignment, Greg's boss asked him to write a piece of software to provide some sort of security from "prying eyes" over emailed documents; these documents would be used internally by the company. This software will subsequently be distributed to different departments.

Upon completion of his software project, Greg saw a program on the local news about an individual in California who has made similar software available overseas. This individual is currently under prosecution in a federal court for the distribution of algorithms and information which (by law) must remain within the United States for purposes of national security.

It occurs to Greg that his company is a multinational corporation and that the software might have been distributed overseas.

Greg discovers that the software has indeed been sent overseas to other offices within the corporation. Greg speaks with his boss, informing him of the local news story from the night before. Greg's boss shrugs off this comment, stating that "The company is based in the United States and we are certainly no threat to national security in any way. Besides, there's no way anyone will find out about software we use internally."

Greg agreed with his boss, and let it go. Later on however, Greg received a letter from a gentleman working as a contractor for his company overseas. Through some correspondence regarding the functionality of the software and technical matters, Greg learned the Middle Eastern office had been supplying his software outside the company to contractors and clients so that they could exchange secure emailed documents.

1. For each of the below – give your thoughts – (about 2 sentences each)

What are Greg's ethical responsibilities as the designer of the software?

What are his ethical responsibilities to his company?

What are his ethical responsibilities to himself?

What are his ethical responsibilities as a citizen?

2. Please give the Golden Rule:

What should Greg do using the Golden Rule?

3. Quote the Utility Rule (Consequential – Utilitarianism):

What should Greg do using the Utility Rule?

4. Give the Deontological Rule:

What should Greg do using the Deontological Rule?

CSE 2642 Ethics Midterm 150 points Name _____

Part One - 25 point Questions – Please use your own words!

1. Name and discuss the influence of greek language, greek people, etc. in the foundation of ethics. Give some specifics.

2. How would you support an argument for the existence of **freedom**, **choice**, **obligations**, and/or **equality**? Discuss at least two of the bold items specifically.

3. Discuss the responsibilities that come with “Computer Ethics” or “Internet Ethics”. Are their limits to the implementation of internet ethics?

4. “Morality and ethics are really about consequence, so questions about morality and ethics only apply for those who’s actions cause harm..”

The above statement is which approach. Explain the approach completely.

Part Two - Fill in the blank and give a **short explanation**. 10 pts each

5. If you approach this problem from a _____ perspective, you will want to do what is best for the majority of employees and for the company itself. So, laying off

5% of the workforce would help to bring about more desirable ends for the greatest number of employees affected by the decision.

6. A _____ perspective on the other hand, will want to choose whichever option is fair to all of the employees (not just the majority). So, everyone would receive a 5 percent cut in pay.

7. In the presentation PG: "Debate on ethical issue example" that is on the class website, Sam & Tom debate their opposing perspectives by providing _____

8. An ethical action includes three related factors:

_____ → _____ → _____

9. Ethical Dilemma: Peer-to-Peer file sharing and networking that facilitated the exchange of music files. Please fill in a feature of the above Ethical Dilemma expressed wrong and right:

Clearly wrong:

Clearly right:

CSE 2642 Ethics Spr 2011 Final Exam 150 points Name _____

USE YOUR OWN WORDS

1. 25 points. Ethics is based on three main sources. Name each of the three sources and give advice about to use them in your life.

a.

b.

c.

2. 25 pts. The following is a snapshot of a method we used to discuss options in ethical dilemmas. Please explain the method using another case of your choice. Be complete in the discussion of the dilemma and advice.

THOUGHTS ABOUT EMAIL ARE:

Clearly wrong

Clearly right

100 million recipients		1 recipient
Unsolicited		solicited
Pornography		Benign content
Fraudulent product		Desired product
Sender unknown		Sender known

3. Discuss how technology has challenge ethical behavior. Give a specific case or scenario where technology made

4. 25 pts. Please give two of the Code of Ethics guidelines. Give the source. Discuss the two guidelines.

5. Discuss the history of ethics, name an old ethical philosopher and their teachings.

In particular, discuss the beginning of computing ethics.

How do you see computing ethics in the future?

6. We studied intentions → action → consequences

a. Give a source of the philosophy focused on intentions. Explain the philosophy. Be complete.

b. Give a source of the philosophy focused on the action. Explain the philosophy. Be complete.

c. Give a source of the philosophy focused on consequence. Explain the philosophy. Be complete.

APPENDIX F: SAMPLE SPSU ICA

Individual Course Assessment
Course Number – Course Title (section(s))
History 1112, Survey of World Civilization, post 1500, 2 sections
Credit hours: 3
Term Year – Instructor
SPRING, 2011, Marianne Holdzkom

Catalog Description:

A survey of the cultural, political, economic, intellectual, social, and scientific development of civilizations from the Age of Exploration to the present.

Learning Outcomes:

Students will be able to:

Discuss the impact of global contact on human populations since 1500

Define the ideologies and technological development that have had the greatest impact on human societies since 1500.

Identify the most important developments in world history over the past five hundred years, and how many of these developments interconnected

Modifications Made to Course (based upon review of earlier ICA's):

I will continue to fight the good fight when it comes to the Big Pictures of History. I will emphasize patterns in Modern World History and make as many connections to the present day as possible.

I will also attempt to do some time-lines for Modern World History. This is little more difficult to do for such a large span of time, but it may help the students to make the connections they need to make. These time-lines will be broad in scope. Yet it will give the students a framework for the connections between movements and ideologies I want them to grasp.

Assessment for Student Outcomes for the Course

Learning Outcome: Discuss the impact of global contact on human populations since 1500.
Method of Assessment: Quiz 1
Performance Criteria: Class average of 70% or better on all measures specified
Results: Section 1: 79%; Section 2: 72%

Learning Outcome: Define the ideologies and technological developments that have had the greatest impact on human societies since 1500.
--

Method of Assessment: Quiz 3

Performance Criteria: Class average of 70% or better on all measures specified
--

Results: Section 1: 76%; Section 2: 78%

Learning Outcome: Identify the most important developments in world history over the past five hundred years, and how many of these developments interconnected
--

Method of Assessment: Final Exam, Short Answer Question 1

Performance Criteria: Class average of 70% or better on all measures specified
--

Results: Section 1: 66%; Section 2: 74%

Student Feedback:

I had several students tell me how much they enjoyed the class. I was pleased especially that two students from my 2:00 class made a point to tell me that they've never enjoyed a history class until now and that they liked that I made history a story for them. This made it easier to understand the events of the past. I was pleased with that because that class was generally quiet and seemingly unengaged. I cannot quantify these comments, but it tells me that I'm on the right track.

Reflection:

Reading my preliminary ICA, I know that I did not achieve what I set out to do this semester with the time-lines. I did however emphasize patterns and connections. I'm disappointed with the students' ability to make these connections even though I taught it. I need to find some methods to help them with this.

Proposed Actions for Course Improvement:

I'll try to think of ways to incorporate those time-lines that I failed to do this semester. I also need to really focus on making connections between each past event. Perhaps I can begin to quiz them on these things immediately so that they are thinking this way from the beginning of the course.

Other Notes:

APPENDIX G: FCAR-RELATED PUBLICATIONS

- [1] J. K. Estell. The Faculty Course Assessment Report. Proceedings of the Best Assessment Processes V Symposium, Rose-Hulman Institute of Technology, Terre Haute, IN (2003)
- [2] J. K. Estell. The Faculty Course Assessment Report. *Frontiers in Education*, 2003. FIE 2003 33rd Annual, pp. T4B-T48 Vol.1, 5-8 Nov. 2003. doi: 10.1109/FIE.2003.1263364
- [3] B. R. Maxim. Closing the Loop: Assessment and Accreditation. *J. Comp. Sci. in Colleges*, 20, 1, 7-18 (2004)
- [4] B. B. Thomas. The Quest for Outcome Assessment: The Faculty Course Assessment Reports. 2005 ASEE Southeast Section Conf. Proc.
- [5] M. S. Meyers, M. L. Anderson, P. J. Parker. Improved Methods of Assessment of the UWP Civil Engineering and Environmental Engineering Programs for the Purposes of ABET Accreditation. online: <http://www.uwplatt.edu/committees/aoc/journals/2005/files/AAFreportmeyers.pdf> (2005)
- [6] B. D. Beheshti, E. A. Nelson, S. Billis, M.M. Drossman. An Iterative Approach to Program Assessment – Best Practices. 9th Intl. Conf. on Engineering Education (2006)
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- [10] H. Rahemi, G. Kizner. Improvement to Faculty Course Assessment Report Template to Facilitate ABET Accreditation Process and Curriculum Success. 5th Latin American and Caribbean Conf. for Engineering and Technology (2007)
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- [16] J.-D. Yoder, J. K. Estell, J. E. Marquart, D. R. Sawyers. Direct Measures Assessment: Adapting ‘Best Assessment Practices’ to a Mechanical Engineering Department. Proc. 2008 ASEE North Central Section Conf. online: <http://www.asee-nc.org/Conferences/Spring08Meeting/Srping08Proceedings/pdf/set2/68.pdf>
- [17] University of Puerto Rico at Mayaguez, Civil Engineering. ABET Self-Study Report for the Civil Engineering Program. online: http://civil.uprm.edu/Self_Studies/ABET_SELF-STUDY_2008_INCI.pdf (2008)
- [18] J. Ansari, A. Javaheri, S. S. Tompkins, K. Williamson. Outcome Assessment Process in a Manufacturing Engineering Program. 2008 ASEE Annual Conf. Proc.
- [19] H. Rahemi, N. Seth. Student Learning Outcomes: An Integrated Continuous Improvement Process for Course and Program Assessment. *Latin American and Caribbean J. of Engineering Education*, Vol. 2(2), 2008, pp. 54-62.
- [20] J. K. Estell. A Heuristic Approach to Assessing Program Outcomes Using Performance Vectors. Proc. of the 2009 Best Assessment Processes Symposium, Indianapolis, IN (2009)
- [21] North Carolina A&T, ABET Self-Study Report for the Chemical Engineering Program, Response to the Final Statement. online: <http://cmsserv.ncat.edu/doclib/%5B69%5D%20ABET,%20Chemical%20Engineering%20Final%20Response%20Report.pdf> (2009)
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- [23] S. Duan, K. Bassett. Development of Faculty Course Assessment Reports for ME Program ABET Accreditation. Proc. ASME International Mechanical Engineering Congress and Exposition (2009)

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