2006-1883: DEVELOPMENT OF A DESIGN PHASE CHECKLIST FOR OUTCOME BASED ACTIVE/COOPERATIVE LEARNING COURSES

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Abstract

Active/cooperative learning and outcome based assessment are among the new tools that engineering colleges ought to use in order to ensure the quality of their graduates in light of ABET EC2000 accreditation policy. In the present work a checklist was developed as a design assistance tool for satisfying the requirements of both active/cooperative learning and ABET EC2000. The checklist includes 66 YES/NO questions to address course goals, course outcomes, course learning objectives, students working teams, course assessment tools, and course evaluation. The questions also address the five pillars of cooperative learning, namely positive interdependence, individual accountability face to face interaction, social cooperative skills, and group processing.

1. Introduction

Modern teaching techniques, such as active/ cooperative learning, hold great promise for increasing the effectiveness of engineering education[1]. As stated by Felder et al[2], a large and rapidly growing body of research confirms the effectiveness of cooperative learning in higher education. Relative to students taught traditionally—i.e., with instructor-centered lectures, individual assignments, and competitive grading—cooperatively taught students tend to exhibit higher academic achievement, greater persistence through graduation, better high-level reasoning and critical thinking skills, deeper understanding of learned material, lower levels of anxiety and stress, more positive and supportive relationships with peers, more positive attitudes toward subject areas, and higher self-esteem.

On the other hand, and in a major shift influenced by pressures from industry and global competition, the Accreditation Board of Engineering and Technology (ABET) has introduced Engineering Criteria 2000 (EC2000)[3], which addressed the effectiveness of engineering education programs by focusing on assessment and evaluation process that assures the achievement of educational objectives and outcomes. Since it was first introduced in 1996, these criteria have been the subject of extensive discussion. In the words of Jack Lohmann[4] cited by Felder et al[2], "Preparing for an ABET visit is no longer the academic equivalent of El Niño—something to be weathered every six years until things go back to normal." Since the work of equipping students with the attributes specified in program outcomes must be done at the individual course level, all faculty members involved in teaching required courses must now understand and be involved in the accreditation process on a continuing basis, not just in the months preceding each visit.

The connection between active/ cooperative learning and EC2000 is strong. Active/ cooperative learning seems to be an efficient way to address the requirements of ABET EC2000. The careful design of an active/ cooperative learning course ensures that students will acquire technical as well as non-technical or soft skills specified in the famous eleven 3a-3k outcomes. Felder et al[2] discuss the instructional paradigms of cooperative learning and problem-based learning and estimates that each of them has the potential to address all eleven Criterion 3 outcomes effectively.

In the present study we aim at combining the major elements of active/ cooperative learning and the requirements of EC2000 in a comprehensive checklist that could be used as an assistance tool for the course design phase. The checklist questions address course goals, outcomes, and learning objectives, in addition to students working teams, course assessment tools, and course evaluation. The questions also address the five pillars of cooperative learning, namely positive interdependence, individual accountability face to face interaction, social cooperative skills, and group processing.

For course outcomes, issues related to clarity, correlation to program outcomes, and correlation to technical as well as non-technical ABET a-k outcomes are addressed. When dealing with learning objectives, the checklist concentrates on the importance of having observable and measurable objectives which are correlated to Blooms levels of learning. These objectives have to follow the sequence of the course, and have to be clearly linked to suitable learning activities. Heterogeneity of students' ability levels, team size considerations, rotation of the roles of team members, team assistance policy, and team maintenance procedures are addressed under "students working teams." Instructional methods have to address the five pillars of active learning, namely; positive interdependence, individual accountability, face to face interaction, social cooperative skills and group processing.

Several questions are related to a balanced grading system for team work and individual contributions, in addition to a balanced load distribution inside the team. The use of open ended and real life problems are encouraged such that the students realize different knowledge levels and aspects inside the team. The importance of the students' reflection on their learning experience, confidence level evaluation, and positive feedback on class activities are also addressed. The use of instructor expectations and assignment checklists, which map into course learning objectives and outcomes, are encouraged as assessment tools. Portfolios, journals, student surveys and questionnaires are also encouraged to ensure triangulation for the assessment of course learning objectives.

Finally course evaluation addresses issues related to the reliability of data gathering and data interpretation as well as course verification and validation and the mechanism of using the results to modify the course.

2. Elements of ABET EC200 Criteria

2.1 Program Educational Objectives and Program Outcomes

ABET EC 2000[3] defines ***Program educational objectives*** as "*broad statements that describe the career and professional accomplishment that the program is preparing graduates to achieve"*. It also defines ***Program outcomes*** as *"statements that describe what the students are expected to know and be able to do by the time of graduation"*.

Program Educational objectives have to be consistent with the mission of the institution, EC 2000 criteria and the needs of the program's various constituencies. ***Program outcomes***, on the other hand must include ABET EC 2000 3a to 3k, the specific engineering program criteria imposed by the corresponding professional society (such as ASME for mechanical Engineering, IEEE for electrical Engineering, AIAA for Aeronautical Engineering, etc), and any additional outcomes articulated to foster the achievement of the program educational objectives.

2.2 Similar Terminology for Course Level

No definition is given by ABET for terms similar to ***objectives*** and ***outcomes*** that may be used in the course level. One must go to literature to identify such terminology and select appropriate definitions to satisfy the following two ABET criteria dealing with courses and curriculum:

- **Criterion 2c**: Each engineering program for which an institution seeks accreditation must have an educational program, including a curriculum, that prepares students to attain program outcomes and fosters accomplishment of graduate that are consistent with program objectives.
- **Criterion 4**: The faculty must ensure that the program curriculum devotes adequate attention and time to each component consistent with program outcomes and objectives.

Since the curriculum is developed into courses, each course has to be divided into components, topics, or competencies that easily map into different program outcomes. Those program outcomes, which can be measured at the time of graduation, are the way by which the program prepares his graduates to achieve the profession and career accomplishments stated in the program objectives.

It is clear that using terms such as ***Course Outcomes*** and ***Course Educational Objectives*** could lead to a lot of confusion with similar program terms. Consequently it is advised to avoid the use of such terms in course design. Instead of writing ***Course Outcomes*** (i.e. knowledge, skills and attitudes that the students who completed the course are expected to acquire), it is sufficient to indicate which ***Program Outcomes*** the course is expected to address. Course components are designed to achieve those ***Program outcomes*** and the assessment of different program core courses is a strong way to measure the degree of achievement of ***Program Outcomes***.

2.3 Course Learning Objectives

Writing detailed clear measurable ***Course Learning Objectives*** (i.e. statements of observable student actions that serve as evidence of the knowledge, skills and attitudes acquired in a course) is the only way to:

- device the ***Program Outcomes*** addressed by the course,
- assist the achievement of those ***Program Outcomes***, and
- improve the successive course offerings.

It is stated by Felder[2&5] and many other researchers[6-7] that: "Learning objectives should begin with observable action words (such as *explain, outline, calculate, model, test, design,* and *evaluate*) and should be as specific as possible, so that an observer should have no trouble determining whether and how well students have accomplished the specified task. Words like *know*, *learn*, *understand*, and *appreciate* are not suitable for use in course learning objectives."
Using descriptive process verbs related to different cognitive levels of learning[8] is highly recommended. Those verbs are, not only, good examples of observable action verbs suitable for course learning objective, but they also indicate the required learning depth (levels of learning).

Once the ***course learning objectives*** are specified, their assessment becomes straight forward[9-10]. In many cases classical exams and homework are suitable and the type of

questions they may include is a simple consequence. In other cases suitable assessment tools could be selected if the required level of learning necessitates their usage. ***Course learning objectives*** could be considered as the elements of a contract between the faculty and the students. The faculty has to specify for each topic in the course what he wants the students to do in order to demonstrate that they mastered this topic.
The faculty can easily write suitable learning objectives to address each topic by considering the target level of learning. The idea of the faculty-student contract implies that if a learning objective defines a certain level of learning, the faculty could not use an assessment tool that addresses a higher level.

2.4 Course Goals

Although course goals are not mandatory for ABET, they facilitate the course design process. Writing down the goals of the course is an efficient way to reflect on the important course aspects, its role in the curriculum and its overall design.

2.5 Course Articulation Matrix

Course Articulation matrix explained by McNeill and Bellamy[11] is a strong tool in course design.
As shown in Appendix A, the articulation matrix for a core course has to include the ***Course Learning Objectives*** and their mapping into the ***Program Outcomes***.

Since there is often a hierarchy associated with competencies, the matrix allows this by having competency categories as well as competencies under each category. In the process explained by McNeill and Bellamy[11], in-class and out-of-class activities are added, one at a time, to the matrix indicating in the body of the matrix which learning objectives are impacted by the activity, and finally indicating the level of learning attainable by this activity.

In order to evaluate the matrix to confirm that the proposed course is complete, there are four considerations to be taken care of. They are,

1. There is at least one Course Activity that impacts each of the competencies (i.e., no empty rows).
2. There is at least one competency impacted by each course activity (i.e., no empty columns).
3. Each row has an adequate number of appropriate course activities that insures progressive evolution between an entry, lower, level of learning to an exit, higher, level of learning.
4. At least 75% of the competencies for a competency category have course activities at the level of learning stipulated for the competency category

Course assessment tools are also added to the matrix in the same way indicating which ***Course Learning Objectives*** are impacted by each assessment tool.

2.6 Course assessment tools

Assessment tools are used in the course level to assist:

- *the course learning objectives*

- *the Program Outcomes* that the course is expected to address

As indicated in Ref. [2], *Triangulation* (using multiple methods to obtain and verify a result) is an important feature of effective assessment[12]. The more tools used to assess a specific course learning objective, the greater the likelihood that the assessment will be both valid and reliable. It is usually advised to use both direct and indirect assessment tools.
Direct assessment tools are used to measure the degree to which each student has achieved each course learning objective by the completion of the course. These direct tools may include classical as well as non-classical methods such as[2]:

- Written tests or test items clearly linked to course learning objectives
- Homework assignments and reports
- Written project reports
- Oral presentations
- Student portfolios, learning logos, and journals
- Abstracts, executive summaries, term papers
- Peer evaluation, self-evaluation
- Written critiques of documents or oral presentations
- Research proposals and student-formulated problems

Clear instructor expectations for each project report or written assignment are essential and detailed checklists have to be prepared for the assessment of each assignment. These checklists have to be mapped into the course learning objectives they are used to assess.

Indirect assessment tools are usually used to assist *the Program Outcomes* that the course is expected to address. Those tools may include different student surveys and questionnaires such as:

- Student surveys for 3a-3k program outcomes related to the course
- Student confidence level in satisfying course learning objectives
- Student evaluation of course instruction

Student surveys and questionnaires could and are advised to be repeated over the course period to assess the progress in the students learning experience. Student portfolios and/or journals could be used as an assessment tool as well as a reflective instrument

Course assessment tools are used as performance indicators for the program outcomes since the course learning objectives are mapped into program (or ABET) outcomes. For each assessment tool it is required to specify a performance target to indicate that the performance of the students has satisfied the program outcome addressed by the course (e.g. 70% of the students are at 70% or higher level in satisfying ABET outcome 3-a in the corresponding set of assignments. Or 70% of the respondents feel they are at least 70% confident to satisfy outcome a, etc)

2.7 Course Evaluation

Course evaluation is similar to testing of a designed computer program if we borrow the nomenclature of the waterfall model from the software engineering.[13] It requires both validation and verification as explained by Ellis in Ref 13. Validation is required to test if the course design goals were met while verification is to make sure that the course functions as

planned. Also as with testing software, it is essential to incorporate feedback from the end users – in the case of a course design, the students.

Data gathered for course evaluation must verify and validate the specifics of the course. The student surveys must address the two aspects:

- The students' level of confidence in attaining the learning objectives specified for the course (course validation), and
- The students' perceptions of the efficacy of the pedagogical tools in facilitating attaining those objectives (course verification).

Data derived from the assessment of the course design is to be treated as if it were experimental data being accumulated over time. It should be analyzed with accepted statistical instruments such as Chi Square as an effective decision support approach.[13]

3. Active/Cooperative Learning Instructional Methods

Active learning could be defined as "a technique used in classroom which employs student-student and student-facilitator interaction in various forms to convert the learning environment from passive to active." As indicated by Bonwell and Eison[14] when using active learning students are engaged in more activities than just listening. They are involved in dialog, debate, writing and problem solving, as well as higher order thinking, e.g., analysis, synthesis and evaluation. Meyers and Jones contend that there are four basic elements that are the building blocks of active learning strategies.[15] These four elements are:

- Talking and listening
- Reading
- Writing
- Reflecting

Although the majority of engineering professors use lecturing as the only mode of instruction, literature shows that students must do more than just listen to truly learn.[16]

Cooperative learning is defined as[17] "the instructional use of small groups so that students work together to maximize their own and each other's learning." The Foundation Coalition[18] uses a structural model drawn from Johnson and Johnson[19] with the following five pillars of cooperative learning (see Felder and Brent[20]):

1. **Positive interdependence.** Team members are obliged to rely on one another to achieve the goal. If any team members fail to do their part, everyone suffers consequences.

2. **Individual accountability.** All students in a group are held accountable for doing their share of the work and for mastery of all of the material to be learned.

3. **Promotive face-to-face interaction.** Although some of the group work may be parceled out and done individually, some must be done interactively, with group members providing one another with feedback, challenging one another's conclusions and reasoning, and perhaps most importantly, teaching and encouraging one another.

4. **Appropriate use of social skills.** Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.

5. **Group processing.** Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future.

3.1 Students Working Teams

Students working teams are the core of cooperative learning, by definition. Based on the work of Johnson, Johnson, and Smith[17], Felder and Brent[20], Millis and Cottell[21] and Felder et al[22], the following items have to be taken into consideration to insure the efficiency of students teams:

- Instructor-formed teams, on average, function better than self-selected teams.
- Teams that are heterogeneous in ability level (based on GBA, prerequisite score, or even a preliminary individual test) benefit more from cooperative learning. Out of my experience, the instructor could select the heads of the teams (the top students) and give them the responsibility to form their teams out of the remaining students. This will guarantee that team members can integrate (and meet) easily while ensuring heterogeneity in ability level.
- Team size is critical. Teams of more than 5 students and teams of less than 3 students usually have difficulties to benefit from cooperative learning. 3-4 students per team is a widely known recommendation.
- Team members assume different roles inside their teams such as leader, checker and recorder. It is recommended to rotate these roles among team members such that each student gets the chance of practicing different responsibilities.
- All team members have to equally participate in producing the work product. Only the names of the students who actually participated should appear on the solution, with their team roles for that assignment identified.
- Assistance to teams whose members having difficulties in working together is necessary if the team fails to resolving its internal conflicts. Nevertheless there must be sufficient restrictions on team dissolving and reconstitution. It is recommended that the same students remain together in teams for sufficiently long periods (at least one month). A team should remain together for at least a month in order to evolve through the "form, storm, norm, and perform" evolution of team development.
- Grading system has to encourage students to cooperate and guarantees they are given grade if they meet a specified standard regardless of the grades of other students. When grades are *assigned on a curve*, the students will recognize that by helping someone else they could be hurting themselves. They may be inclined to avoid cooperation, making it less likely that the benefits of cooperative learning will be realized.

3.2 Instructional Methods to Address "Positive Interdependence"

Positive interdependence between team members is achieved when one team member cannot succeed unless all team members succeed. This can be achieved using several in-class cooperative learning structures; frameworks within which faculty members can construct cooperative learning activities. Based on the material from the foundation coalition web site[16&18] the following examples are good and easy to implement structures which support the

inclusion of the five elements of cooperative learning (see Barbara Millis, U.S. Air Force Academy[23]):

- Jigsaw: Material to be learned is divided into separate components. Groups of students are assigned responsibility for each component and learn together how to teach that component. Then, teams with one individual responsible for each component come together to teach each other the entire set of material. First, students work together to learn how to best teach the material for which they are responsible. Second, students interact in their final teams to teach each other what they have learned.
- Think-Pair-Share: Learners individually think about a question, share their thoughts in pairs, and then selected members share the thoughts of their pairs with the entire class.
- Scripted Cooperation: A pair of learners both read an assignment. Without referring to the reading material, one learner describes what was in the reading material while the other learner listens, identifies errors, and offers corrections. Both learners refer to the reading assignment, and reverse roles. Studies indicate both improvements in comprehension as well as the transfer of learning skills when reading individually.

In order to promote positive interdependence the grading system has to allocate at least 50% of the final grade to common in-class and out-of-class team work. Bonuses could be given to teams for which lowest or averaged member grade in an individual test exceeds a specified minimum. Open ended problems could be used to encourage team members to generate ideas before reaching a team consensus answer. Real-life applications are enforced such that students realize the different knowledge other students have. Finally out-of-class activities must be designed such that all team members have to participate.[20]

3.3 Instructional Methods to Address "Individual Accountability"

The most common way to achieve individual accountability is to give primarily individual tests; another is the technique of randomly selecting an individual team member to present or explain the team's results. Some authors suggest having each team member rate everyone's effort as a percentage of the total team effort on an assignment and using the results to identify non-contributors and possibly to adjust individual assignment grades[20]. Others encourage learning structures (such as Jigsaw) which enforce "teach it to someone else". Nevertheless an effective way is to allocate at least 25% of the final grade to individual in-class tests and individual out-of-class assignments. Finally individual accountability is to be addressed through individual process check and feedback actions (such as +/Δ or muddiest point).

3.4 Instructional Methods to Address "Face-to-Face Interaction"

Several in-class cooperative learning structures that include Face to Face Interaction has to be encouraged. These structures include:

- Peer Instruction,
- Jigsaw,
- Hands on Projects,
- Structured Academic Controversy, etc

Out-of-class Face-to-Face Interaction is guaranteed through mandatory team meetings. Team meetings agendas and minutes must be an integral part of out-of-class assignments. Students

are to be asked to reflect on how the team helped individual learning. This reflection is an integral part of course portfolios, journals and logos.

3.5 Instructional Methods to Address "Social Cooperative Skills"

Teams are encouraged to develop and to adhere to a Code of Cooperation or Team Norms. In-class activities that include criticizing ideas without criticizing persons (such as structured academic controversy and scripted cooperation) have to be encouraged. Critical and creative listening skills, oral and written communication skills, and in-class and out-of-class critical reading activities are to be enhanced. Use of computers and modern engineering tools, information gathering skills and modern on line search techniques are to be encouraged.

3.6 Instructional Methods to Address "Group Processing"

- Students are encouraged to reflect on their learning experience (using journals, portfolios, etc).
- Teams are encouraged to self-assess their own work before being assessed by the instructor.
- Student-student peer assessment is used to evaluate some written and oral assignments.
- Students are encouraged to give positive feedback on class activities (using +/Δ or muddiest point).
- Students are encouraged to evaluate their confidence level in attaining the course learning objectives (using suitable questionnaires).
- Students are encouraged to evaluate the effect of different instructional tools on attaining the course learning objectives (using suitable questionnaires)?

4. Design Phase Assessment Checklist

The Design Phase Assessment Checklist for an Outcome Based Active/Cooperative Learning Course is given in the Appendix. The checklist is designed to be a self assessment tool for the team who designs an active/cooperative outcome based course. It could be also used by a college committee to evaluate different similar courses.

4.1 Using the Checklist as a Self Assessment Tool

The checklist was developed as a part of the active learning fluid mechanics course detailed in Ref 24. The checklist was applied on the first draft of the designed course to indicate the items that need further improvements. These items included:

- Item 12: the "in" level of learning for each competency was not specified. After some discussions and since the course is an introductory one it was decided to consider "unaware" as the entry level of learning for each competency.
- Item 25: the starting idea was to apply the process gradually for one section only in order to compare the results and evaluate the experience. In this first phase it was difficult to allocate more than 20% of the grade for common in-class and out-of-class team activities. The remaining 80% is allocated to individual exams that are common for both active learning and classical sections. It is understood that for upcoming course offerings 60% of the grade will be allocated to team assignments.
- Item 26 was also postponed.
- Item 32: In the first phase team reports are limited to those prepared in class. Individual contributions to these reports are guaranteed by direct facilitator supervision.

- Items 40, 49, and 60: the use of portfolios and journals were considered as an extra excessive student's load in the first phase. Portfolios are to be used in upcoming course offerings.

4.2 Using the checklist as a Peer Assessment tool

The checklist could be used to evaluate both active/cooperative courses as well as classical outcome based courses. In both cases the part entitled "*Comment or additional information on any No*" plays an important role as well as face-to face interaction between course designers and course evaluators.

The checklist for classical outcome-based courses includes items 1 through 14 and items 55 through 66 which cover course goal, outcomes, learning objectives, assessment tools and evaluation. The Academic Accreditation Unit (AAU) of King AbdulAziz University, Faculty of Engineering, is considering using this checklist to partially evaluate courses redesigned to satisfy ABET EC 2000 requirements.

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Appendix

Design Phase Checklist for an Outcome Based Active/Cooperative Learning Course

Checklist Item	Yes	No
Course Goal		
1. Is the Course Goal clearly stated in a short, agreed upon, statement?		
2. Does the Course Goal encompass the goal of the corresponding traditional course (if any)?		
Course Outcomes		
3. Are the Course Outcomes (i.e. knowledge, skills and attitudes that the students who complete the course are expected to acquire) stated clearly		
4. Does some of the Course Outcomes map into or be identical to one or more curriculum outcomes?		
5. Do the Course Outcomes address more than one technical outcome of the ABET 3a-3k (a, b, c, e, and k?		
6. Do the Course Outcomes address more than one non-technical outcome of the ABET 3a-3k (d, f, g, h, i, and j)?		
Course Learning Objectives		
7. Are there well defined observable outcome related Learning Objectives which are guaranteed to be in place regardless of who happens to teach the course (i.e. measurable actions that the students should be able to perform if they mastered the course)?		
8. Are the Learning Objectives expressed using "Upon completing the course, students should be able to:" or a similar format		
9. Does each Learning Objective begin with a clear, unambiguous, observable, and measurable action word		
10. Are all the action words selected from the process descriptive verbs related to Bloom's Levels of Learning?		
11. Are the Course Learning Objectives grouped into competency categories and competencies which follow up the sequence of the topics covered in the course?		
12. Are "in" and "out" Levels of Learning clearly stated for each competency?		
13. Is the degree of impact (High, Medium, or Low) of each in-class and out-of-class learning activity on each competency indicated?		
14. Is the targeted level of learning for the activities of High and Medium degree of impact indicated?		
Students' Working Teams		
15. Is there a clear policy to ensure that the teams are heterogeneous in ability levels		
16. Is there a clear policy concerning the size of the team (3-4 students per team is a widely known recommendation)?		
17. Is there a clear policy to ensure that team members can meet easily?		
18. Is there a clear policy to rotate the roles of team members (leader, checker, and recorder) from assignment to assignment?		
19. Is there a clear policy to insure that all team members equally participate in producing the work product?		

Checklist Item	Yes	No
20. Is there a policy to provide assistance to teams having difficulties in working together?		
21. Is there a policy to ensure that the same students remain together in a team for sufficiently long periods (at least one month)?		
22. Is there sufficient restriction on team dissolving and reconstitution?		
23. Does the grading system encourage students to cooperate and guarantees they are given grade if they meet a specified standard regardless of the grades of other students?		
Instructional Methods to Address the 1st Pillar of Active/ Cooperative Learning: "Positive Interdependence"		
24. Are there "in-class activities" to address positive interdependence so that one cannot succeed unless all team members succeed (e.g. Think-Pair-Share, Jigsaw, Think Aloud-Pair Problem Solving etc.)?		
25. Does the grading system allocate at least 50% of the final grade to common in-class and out-of-class team work?		
26. Is there any bonuses given to teams for which lowest or averaged member grade in an individual test exceeds a specified minimum?		
27. Are open ended problems used to encourage team members to generate ideas before reaching a team consensus answer?		
28. Are real life applications enforced such that students realize the different knowledge other students have?		
29. Are out-of-class activities designed such that all team members have to participate?		
Instructional Methods to Address the 2nd Pillar of Active/ Cooperative Learning: "Individual Accountability"		
30. Does the grading system allocate at least 25% of the final grade to individual work?		
31. Are learning structures (such as Jigsaw) which enforce "Teach it to someone else" encouraged?		
32. Is individual contribution to team reports demonstrated and rewarded?		
33. Is random checking (i.e. selecting students at random to answer a question) used to assist individual accountability?		
34. Are individual quizzes, examinations, presentations, etc, planned to be used during the course?		
35. Is it guaranteed that the team member who presents the team work will be randomly selected?		
36. Is it planned that some of the out-of-class activities are individually assigned and graded?		
37. Are some of the process check and feedback actions (such as +/Δ or muddiest point) required individually?		
Instructional Methods to Address the 3rd Pillar of Active/ Cooperative Learning: "Face to Face Interaction"		
38. Are in-class activities that include Face to Face Interaction (such as Peer Instruction, Jigsaw, Hands on Projects, Structured Academic Controversy, etc) encouraged?		
39. Are out-of-class team meetings encouraged and team meetings agendas and minutes required?		

Checklist Item	Yes	No
40. Are the students asked to reflect on how the team helped individual learning?		
Instructional Methods to Address the 4th Pillar of Active/ Cooperative Learning: "Social Cooperative Skills"		
41. Are Teams encouraged to have a Code of Cooperation or Team Norms?		
42. Are there class activities that include criticizing ideas without criticizing persons (such as structured academic controversy and scripted cooperation)?		
43. Are there class activities that enhance critical and creative listening skills (such scripted cooperation)?		
44. Are oral communication skills enhanced through class presentations?		
45. Are written communication skills enhanced through report writing?		
46. Are reading assignments frequently used in and out of class?		
47. Is the use of computers and modern engineering tools encouraged?		
48. Are both information gathering skills and modern on line search techniques encouraged?		
Instructional Methods to Address the 5th Pillar of Active/ Cooperative Learning: "Group Processing"		
49. Are the students encouraged to reflect on their learning experience (using journals, portfolios, etc)?		
50. Are the teams encouraged to self-assess their own work before being assessed by the instructor?		
51. Is the student-student peer assessment used to evaluate some written or oral assignments?		
52. Are the students encouraged to give positive feedback on class activities (using +/Δ or muddiest point)?		
53. Are students encouraged to evaluate their confidence level in attaining the course learning objectives (using suitable questionnaires)?		
54. Are the students encouraged to evaluate the effect of different instructional tools on attaining the course learning objectives (using suitable questionnaires)?		
Course Assessment Tools		
55. Are there clear Instructor Expectations for each project report or written assignment		
56. Are detailed Checklists prepared for the assessment of each assignment?		
57. Are the Checklists mapped into the program outcomes which the course is expected to address?		
58. Is triangulation (i.e. several assessment tools) used for the assessment of the Course Learning Objectives?		
59. Are the student surveys and questionnaires repeated over the course period to assess the progress in the students learning experience		
60. Are students portfolios and/or journals used as an assessment tool as well as a reflective instrument		

Checklist Items	Yes	No
61. Is there a performance target to indicate that the performance of the students satisfied the ABET outcomes addressed by the course (e.g. 70% of the students are at 70% or higher level in satisfying ABET outcome 3-a in a set of assignments, 70% of the respondents feel they are at least 70% confident to satisfy outcome 3-a, etc)		
Course Evaluation		
62. Is there a reliable method of data gathering for course evaluation?		
63. Is there a clear method for interpreting the evaluation data?		
64. Does the evaluation data address the course verification by answering the question: "Did the course function as planned?"		
65. Does the evaluation data address the course validation by answering the question: "Were the course goals, outcomes and/or objectives met?"		
66. Is there a clear methodology to use the verification and validation results to modify the course?		
Comment or additional information on any No		