# Supporting ABET2000
# The NMSU Student-Faculty Interaction Program

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## Abstract

As part of the ABET2000 accreditation process (Accreditation Board of Engineering and Technology), engineering programs are required to "describe faculty involvement in interactions with students", and "describe the assessment process, document the process by which the assessment results are applied, and provide data that shows the processes are working and producing the desired results".

This paper presents a process documenting faculty/student interaction using qualitative and quantitative data collection. This process can used by engineering programs for the ABET2000 accreditation. It describes how data was collected and analyzed by faculty to increase student achievement and retention.

This program was offered in selected classes from all engineering departments at New Mexico State University (NMSU), Electrical Engineering, Industrial Engineering, Chemical Engineering, Mechanical Engineering, and Civil Engineering. The authors collected data on observed interactions during classes and between classes with faculty and students, met with faculty to discuss the interactions, and suggested interventions to improve student achievement and retention.

While ABET requires documentation of faculty/student interaction, many faculty have experienced the diversity of student interactions both in and out of class. Research indicates different students have different interactive learning styles. In fact, a student's interaction style is another dimension of that student's learning style.

This study is an empirical investigation of student-faculty interactive learning patterns, their effects on student achievement and retention, and how this information can be documented for the ABET2000 Accreditation, Program Self-Study.

## ABET2000 Accreditation Process

The Secretary of Education of the United States Department of Education lists ABET (Accreditation Board of Engineering and Technology) as the nationally recognized agency responsible for accreditation of educational programs leading to degrees in engineering. To attain this recognition, ABET must include as part of the accrediting process an institutional or program self-study and an on-site review by a visiting team. The self-study is expected to be a qualitative assessment of the strengths and limitations of the institution or program, including the achievement of institutional and program objectives, and should involve broad and appropriate constituent groups in its preparation and process [1].

The ABET Engineering Criteria 2000 is based upon *what students learn* in the course of their program of studies as opposed to what they are presented in a curriculum. Consequently, institutions are required to have educational objectives and to employee outcomes assessment techniques to determine the degree to which program goals and objectives are being attained. The assessment, in turn, is used in an ongoing process of improving student learning through enhancements to the program [1].

The Program Self-Study Report provides information for both a qualitative and quantitative assessment. As part of the program self-study report, engineering programs are required to describe how their programs satisfy several criterion [1]. The following are the criterion which can be quantified by the Student-Faculty Interaction Program.

Criterion 2. Program Educational Objectives - Discuss in detail the educational objectives, the process by which these objectives are determined and evaluated, how the program ensures these objectives are achieved, and *the system of ongoing evaluation that leads to continuous improvement of the program*, as required by Criterion 2.

- Describe how the program curriculum and processes ensure achievement of the Program Educational Objectives. *Provide data* that shows the process are working and producing the desired results and that the results are being used to improve the effectiveness of the program.

Criterion 3. Program Outcomes and Assessment - Describe the assessment process, *documented results*, and evidence that results are applied to further development and improvement of all outcomes, important to the missions of the institution and the objectives of the program, as required by Criterion 3.

- *Describe the process by which the assessment results are applied to further develop and improve the program.*
- *Document the process by which the assessment results are applied to further develop and improve the program*
- *Describe the materials that will be available for review during the visit to demonstrate achievement of the Program Outcomes and Assessment.*

Criterion 5. Faculty - Demonstrate that the faculty have the competencies to cover all the curricular areas of the program and show that the faculty is of sufficient number to accommodate *student-faculty interaction*, advising and counseling, service activities, *professional development*, and *interaction with practitioners* and employers, as required by Criterion 5.

- Describe *faculty involvement in interactions with students*, in advising, in service, in professional development, and interactions with industry.

## Interactive Styles of Engineering Students

While research does suggest that interacting with faculty is important for student development [2], not all students interact with faculty in the same manner. Students have a dominant interaction style. Interaction styles are the way, and with whom, students interact when they learn. There are four basic interaction styles [3]:

- Student-faculty-formal (during class): students who learn best by interacting with faculty during class
- Student-faculty-informal (outside of class): students who learn best by interacting with faculty outside of class (after class, during office hours, through email or phone)
- Student-Student: students who learn best by interacting with other students (both during class and outside of class)
- Student-Self: students who learn best by not interacting with the faculty or other students

Research suggests the engineering students who are most successful, the seniors and white students, have the interactive style which is traditionally used most often in engineering programs, students learning by themselves. While the students who are less likely to be retained in the engineering courses, freshmen and minority students, have different interactive styles. Freshman report the interaction which best supports their learning is learning with faculty outside of class and minority students report learning with other students. In addition, while both males and females report their most successful interactive style was learning by themselves, the males' second most successful style was learning with other students, while the females' was learning with the faculty outside of class [3]. Many engineering programs are including team work and group work as part of their curriculum, while few are incorporating informal faculty interaction as part of their curriculum.

By using the information learned about interactive styles, faculty can become aware of alternative instructional styles which can encourage the participation and inclusion of diverse students. These observed differences in interactive styles suggest multiple instructional strategies may be helpful in creating successful learning opportunities for diverse students.

## Data Collection

Beginning in the spring of 1999, the authors began observing in selected Civil Engineering and Mechanical Engineering courses at NMSU. In the fall of 1999, the authors began observing in selected Industrial Engineering, Electrical Engineering, and Chemical Engineering courses. Data were collected on student interactions with faculty, and student interactions with other students, during and between classes.

The authors observed the participating classes approximately once a week, and collected

data on who was interacting, and in what way, during class. The authors observed for specific interaction patterns during class. The authors had discussed these specific behaviors with the faculty before observing the class. Classroom observations were collected using the data collection sheet, Appendix A.

The faculty collected data on student interactions between classes using the data collection sheet, Appendix B. These interactions took place outside of class; during office hours, in the hallways, during labs, or anytime students stopped to speak to the faculty about course related topics.

Students enrolled in the selected engineering courses completed an Interactive Learning Style Instrument [4] , Appendix C, which determined students' preferred interaction style. All students participating in the study signed permission forms and were assured their data would be confidential and given only to their professor and the researchers. The professor noted the students' interactive style on the grading sheets for use during the semester. Once the professor understand a student's interactive style, s/he has the information necessary to provide opportunities to support the interactive style of that student.

## Classroom Observation Patterns

During the fall 1999 semester at NMSU the authors collected data in the participating engineering courses. The data collected during classes included; faculty initiated interactions (faculty questions) with student responses (answers), student initiated interactions (students ask question of the faculty or made a comment about course material), interactions with faculty directly after class, and students interacting with other students during or directly after class. Classroom observation data is shown in Table 1.

Table 1
Observed Student-Faculty Interactions During and After Class by Respondent Demographics

| | W-M | W-F | H-M | H-F | I-M | I-F | Total |
|---|---|---|---|---|---|---|---|
| Class Demographics | 47% | 11% | 26% | 10% | 2% | 1% | 100% |
| Faculty Initiated/During Class | 51% | 16% | 23% | 8% | 1% | 0% | 100% |
| Student Initiated/During Class | 51% | 11% | 32% | 5% | 0% | 0% | 100% |
| Student-Faculty Interaction/After Class | 55% | 14% | 16% | 4% | 9% | 0% | 100% |
| Student-Student Interaction/During Class | 49% | 11% | 34% | 5% | 0% | 0% | 100% |
| Student-Student Interaction/After Class | 43% | 21% | 25% | 11% | 0% | 0% | 100% |

While white-male students made up 47% of the students attending the classes, they responded to 51% of the questions the professor asked and initiated 51% of the questions asked

by students to the faculty. The white-male students also initiated 55% of the interactions with professor directly after class and 49% of interactions with other students.

White-female students made up 11% of the students attending classes and answered 16% of the questions initiated by the professor during class. They were also more likely to discuss academic matters after class, initiating 14% of the interactions with the professor and 21% of the interactions with other students directly after class. It is not uncommon to see a line of female students waiting to speak to the professor before s/he leaves the room after class. Usually, these females are at the end of the line, waiting until all males have asked their questions.

Hispanic-male students made up 26% of the students attending the classes and initiated 32% of the questions asked of the professor and 34% of the interactions with other students after class. While the male, American Indian students made up 2% of the students and initiated 9% of the interactions with the professor directly after class. The Hispanic female and American Indian females did not proportionately interact with the professors or other students during or after class.

## Intervention Strategies

The researchers also met with the faculty to discuss classroom observations and suggest strategies which will support students interactive styles. One of the simplest, yet most important strategy recommended was for the faculty to learn and use students' names. Most faculty know students' names, yet don't address them by name, either during or between classes. Many students don't realize their professors know their name, and feel they are invisible. Regardless of a student's dominant interaction style, students participate more actively in their education when they are acknowledged by name during and between classes by faculty, secretaries, lab technicians, and department heads.

We suggest faculty call on students by name during class. It is common for a few students to answer all the questions during class. Faculty and students admit they allow these verbal student to do the talking for the entire class. It is also common for faculty to look at the students who always answer, giving non-verbal cues that the faculty expects them to answer. When these students don't answer, perhaps because they don't know the answer, other students, if given the opportunity, will answer. By calling students by name in class, the faculty are offering the opportunity for the more silent students to participate, inviting these students to become involved in their education.

We suggest faculty look at the grades of the students, at least by mid-term, and intervene if there appears a problem. Some students can become "stuck", on a particular concept, homework, or lab, which affects their grade from then on. If a professor becomes aware of problems and speaks to the student, either recommending tutoring, help for test anxiety, or training for study skills, note taking, or reading technical books, students can raise their grades. These services are available on the NMSU campus through the Center for Learning Assistance.

This is especially important with "border-line" students, those students who are one or two points away from making a grade. Discussing their course work, quizzes, homework, and

tests can help the border-line "D" student to receive a "C", or the border-line "C" student to receive a "B". This is important for those students who have a dominant faculty-student interactive style and who have not ever met with their professors. It is also important for students who are self-interactors, those students who do not interact with the faculty or other students. If they can not understand the material by themselves, they are likely to withdraw or fail, unless the faculty intervenes.

## Student Results - Increased Retention and Achievement

As seen in Table 2, 80% of the students who were Student-Faculty-Formal interactors, those students who learn best by interacting with the faculty during class, receive a grade of an "A", "B", or "C" as their final grade, perhaps because in working with this program, there was more interaction between the faculty and students during class this semester. 24% of the Student-Faculty-Informal interactors, those students who learn best by interacting with the faculty in an informal environment, outside of class, withdrew from the course. Perhaps because they did not create the opportunity to interact with the faculty outside of class.

Table 2
Student Grades by Interaction Type

| | A | B | C | D | F | W | Total |
|---|---|---|---|---|---|---|---|
| Student-Faculty-Formal Interactors | 35% | 25% | 20% | 10% | 5% | 5% | 100% |
| Student-Faculty-Informal Interactors | 40% | 24% | 6% | 6% | 0% | 24% | 100% |
| Student-Student Interactors | 27% | 32% | 19% | 6% | 3% | 13% | 100% |
| Self Interactors | 32% | 21% | 25% | 4% | 4% | 14% | 100% |

There was an average increase of 8% in student retention and achievement from the semester before the faculty participated in the program to the current semester. This was measured by students' final course grades and the number of students failing or withdrawing from the courses. As seen in Figure 1, the participating courses increase the number of students who received the grade of A, B, or C during the research semester from 7-11%.

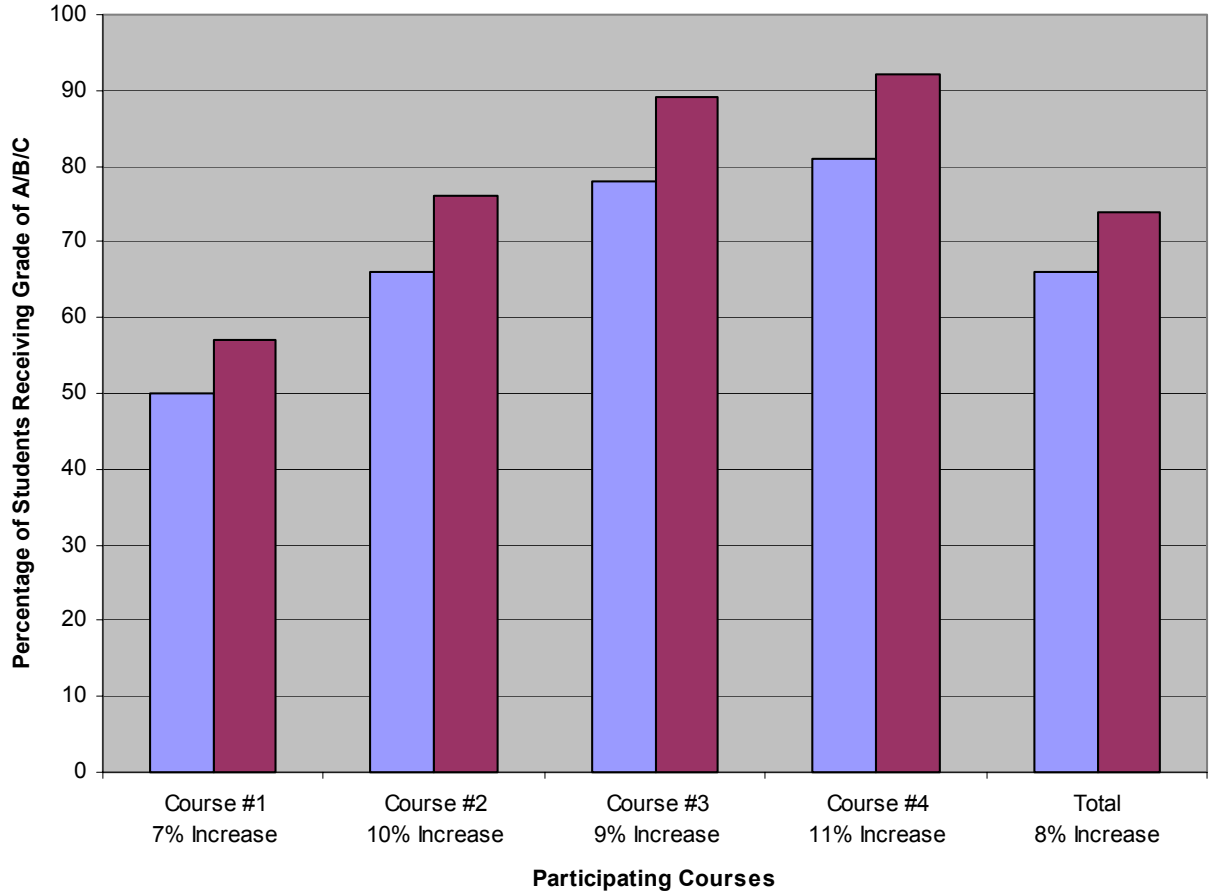


Figure 1: Student Results Before & After Research Semester

## ABET Documentation

As part of the ABET2000 process, engineering programs are required to "describe faculty involvement in interactions with students", and "describe the assessment process, document the process by which the assessment results are applied, and provide data that shows the processes are working and producing the desired results".

This program supports the data collection for ABET2000 Self-Study Report. This data documents the faculty involvement in interactions with students and the process by which the results were applied. This program also documents the desired results of greater student achievement and retention as seen through student grades.

## Bibliography

[1] Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. (1999). Engineering Criteria 2000: Program Self-Study Instructions. Available on-line at http://www.abet.org/

[2] Kariuki, P. N. (1995). The relationship between student and faculty learning style congruency and perceptions of the classroom environment in colleges of teacher education. Paper presented at the annual meeting of the Mid-South Educational Research Association. (ERIC Document Reproduction Services No. ED 393 819)

[3] McShannon, J.R. & Derlin, R. (1999). Interactive learning styles of undergraduate engineering students in New Mexico: A new model. Paper presented at the annual conference for the American Society of Engineering Education, Dallas, TX, March, 1999.

[4] McShannon, J.R. (1998) Interactive Learning Style Inventory. Las Cruces, NM.

**Appendix A - Formal Interaction - Data Collection Sheet**

| **Date**:_____ | **Class**: _____ | **Time**:_____ | | | **Observer:** _____ | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | White-M | Wh.-F | His-M | His-F | I.M | I.F | Other | Class | TOTAL |
| Number of Students --> | | | | | | | | | |
| **INTERACTION - FACULTY INITIATED** | | | | | | | | | |
| Simple Question(s) | | | | | | | | | |
| Listening | | | | | | | | | |
| Simple Feedback | | | | | | | | | |
| Wait Time (3-5 seconds) | | | | | | | | | |
| Multiple quest.one topic | | | | | | | | | |
| Unacknowledged answer(s) | | | | | | | | | |
| Analytical Feedback | | | | | | | | | |
| Complex Questions | | | | | | | | | |
| Total | | | | | | | | | |
| **INTERACTION - STUDENT INITIATED** | | | | | | | | | TOTAL |
| Simple Question(s) | | | | | | | | | |
| Listening | | | | | | | | | |
| Simple Feedback | | | | | | | | | |
| Wait Time (3-5 seconds) | | | | | | | | | |
| Multiple quest.one topic | | | | | | | | | |
| Unacknowledged answer(s) | | | | | | | | | |
| Analytical Feedback | | | | | | | | | |
| Complex Questions | | | | | | | | | |
| Total | | | | | | | | | |
| **STUDENT-STUDENT INTERACTION - In Class** | | | | | | | | | TOTAL |
| Student-Student | | | | | | | | | |
| **STUDENT-STUDENT INTERACTION - After Class** | | | | | | | | | TOTAL |
| Student-Student | | | | | | | | | |
| **STUDENT-FACULTY INTERACTION - After Class** | | | | | | | | | |
| Simple Question(s) | | | | | | | | | |
| Listening | | | | | | | | | |
| Simple Feedback | | | | | | | | | |
| Wait Time (3-5 seconds) | | | | | | | | | |
| Multiple quest.one topic | | | | | | | | | |
| Unacknowledged answer(s) | | | | | | | | | |
| Analytical Feedback | | | | | | | | | |
| Complex Questions | | | | | | | | | |

**Appendix B**
**Informal Interaction - Data Collection Sheet**

Fall 1999
Course: _____

Directions: For each informal interaction (outside of class) complete a line of the table by checking (✓) the appropriate information.

| Date | Type of Interaction | | | | | | Level of Interaction | | | | | | Student Gender | Student Ethnicity | | | | | | Reason for Interaction/ Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | After class | Before class | Office | email | phone | Other | Response Opportunity | Analytical Feedback | Wait Time | Probing | Listening | Higher ?s | Female | White | Hispanic | Black | Asian | Indian | Other | |
| | | | | | | | | | | | | | Male | | | | | | | |
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**Appendix C**
**Interactive Learning Style Inventory**

This inventory gives you the opportunity to describe how you **learn best**. There are no right or wrong answers. Read each statement and decide to what extent you agree or disagree with the statement. Think about what you do when you are learning something new and difficult, how do you **learn best**? Then give your immediate or first reaction to the statement. Don't base your response to the statement on what you do for this particular class or even at this college. Circle the one number that best describes what you do most of the time when you **learn best**.

Circle:
1 if you strongly disagree
2 if you disagree
3 if you are neutral
4 if you agree
5 if you strongly agree

The first two pages ask about what you do to learn best **during class**. The next page ask what you do to learn best **when studying**.

For the following statements, describe how you **learn best** *during class*. When you are learning something new or difficult *during class*, what do you do to **learn best**? Circle the one number that best describes what you do most of the time when you **learn best**.

| Please read and respond to every statement. | Circle only one number. | | | | |
|---|---|---|---|---|---|
| | Strongly Disagree | | Neutral | | Strongly Agree |
| 1. During class, the way I learn best is asking the teacher questions. | 1 | 2 | 3 | 4 | 5 |
| 2. During class, the way I learn best is, if I don't understand how the teacher is solving a problem, I ask a student for clarification. | 1 | 2 | 3 | 4 | 5 |
| 3. During class, the way I learn best is, working things out for myself. | 1 | 2 | 3 | 4 | 5 |
| 4. During class the way I learn best is, if I don't understand something, I work it out for myself. | 1 | 2 | 3 | 4 | 5 |

| Please read and respond to every statement. | Circle only one number.<br>Strongly Disagree — Neutral — Strongly Agree | | | | |
|---|---|---|---|---|---|
| 5. During class the way I learn best is, if I don't understand how the teacher is solving the problem, I ask the teacher for clarification. | 1 | 2 | 3 | 4 | 5 |
| 6. During class the way I learn best is, if I don't understand something, I ask a student sitting near me. | 1 | 2 | 3 | 4 | 5 |
| 7. During class the way I learn best is, if I don't understand how the teacher is solving a problem, I work the problem for myself. | 1 | 2 | 3 | 4 | 5 |
| 8. During class the way I learn best is, if I don't understand something, I ask the teacher. | 1 | 2 | 3 | 4 | 5 |
| 9. During class, the way I learn best is talking with the other students. | 1 | 2 | 3 | 4 | 5 |

For the following statements, describe how you **learn best** *studying, outside of class*. When you are ***studying*** something new or difficult *outside of class* what do you do to learn **best**? Circle the one number that best describes what you do most of the time when you **learn best**.

| Please read and respond to every statement. | Circle only one number. Strongly Disagree | | | | Strongly Agree |
|---|---|---|---|---|---|
| 10. When studying the way I learn best is, if I don't understand something, I go ask the teacher. | 1 | 2 | 3 | 4 | 5 |
| 11. When studying the way I learn best is, I ask the teacher questions. | 1 | 2 | 3 | 4 | 5 |
| 12. When studying the way I learn best is, if I don't understand how to solve a problem, I ask a student for clarification. | 1 | 2 | 3 | 4 | 5 |
| 13. When studying the way I learn best is, if I don't understand how to solve a problem, I ask the teacher for clarification. | 1 | 2 | 3 | 4 | 5 |
| 14. When studying the way I learn best is, if I don't understand something, I work it out by myself. | 1 | 2 | 3 | 4 | 5 |
| 15. When studying the way I learn best is, if I don't understand how to solve a problem, I work it through by myself. | 1 | 2 | 3 | 4 | 5 |
| 16. When studying the way I learn best is, asking questions of the teacher. | 1 | 2 | 3 | 4 | 5 |
| 17. When studying the way I learn best is, if I don't understand something, I ask another student. | 1 | 2 | 3 | 4 | 5 |

**Thank you!**