

A Qualitative Measurement Method for an Undergraduate Mechanical Engineering Program

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Abstract

The faculty of a Bachelor of Science in Mechanical Engineering (BSME) program in the College of Arts and Sciences at a private university wished to know how two groups of stakeholders, current students and the parents of current students, perceived the program. Program administrators and staff could use these sources of information to gain qualitative data as it prepared for accreditation by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology (EAC of ABET) in 2000 and for its Baldrige Quality Award application in 2002. For two consecutive years, parents of current BSME students were invited to a day-long campus visit in April into which activities to gather impressions via a two-step focus group were imbedded. Data collected over two years was analyzed for results in accordance with the department Continuous Improvement Plan. Results confirmed positive aspects of the program and provided important feedback for improvement. Actions taken on results include EAC of ABET accreditation for the BSME program and the launching of a BSEE program. This qualitative approach supplements quantitative measurements and serves as an excellent relationship-building approach with important program stakeholders.

Introduction and Rationale

Faculty members of a private, midwestern university serving 250 engineering graduate students and 180 engineering undergraduates wished to know how two groups of undergraduate program stakeholders—current students and the parents of current students—perceived the program. As part of its Continuous Improvement Process (see Appendix A), the program had chosen a combination of quantitative and qualitative assessment methods to monitor progress toward improvement goals. Qualitative assessment approaches would complement other methods such as a Senior Self-assessment Survey of Program Educational Objectives and Outcomes, the FE Exam, and Instructor/Course Evaluations by soliciting important, unquantifiable feedback. The program administrators and staff could use these sources of information as it prepared for accreditation by the Engineering Commission of the Accreditation Board of Engineering and Technology (EAC of ABET) in 2000 and for its Baldrige Quality Award application in 2002.

In the fall of 1999, the engineering program director secured a consultant from the university's Department of Organization Learning and Development to design and conduct a measurement method in collaboration with the department chair and administrative staff. Together they designed a qualitative assessment approach to gather impressions from a self-selected group of

current students (freshmen to seniors) and from their parents. Particularly interested in such intangibles as lifelong learning and critical thinking, the department chair, faculty and staff believed that capturing oral or written subjective impressions and perceptions would add to the quantitative data derived from Likert-scale Senior Self-assessment ratings on Program Educational Objectives and Outcomes. Three key questions shaped the design: 1) What's going on? 2) What does the department want to know from its stakeholders? and 3) Why does it matter? While considering the answers to these questions, designers were forced to revisit the BSME program vision/mission/values, strategies and objectives. The three questions then became five:

1. Why had the students/parents chosen the BSME major?
2. Why did they choose this BSME program at this university?
3. What did the students perceive they were learning?
4. What impressions did the parents have of the program and setting?
5. What recommendations would the parents make for change?

Process

Parents of current BSME students had been invited to a day-long campus visit scheduled for April, 2000 so that parents could experience firsthand the learning atmosphere the department had created to foster the academic and professional development of their sons and daughters. For the visit, activities were designed to gather impressions from both a group of students and parents (some of them were the students' own parents) using short questionnaires and two focus group sessions. A two-step process was embedded into the agenda of a one-day parents' campus visit. The two-step process used two methods to gather impressions: guided focus groups and written questionnaires. The agenda looked like this:

9-11 a.m.	Open tours of engineering labs
11-noon	Overview session for parents
noon –1	Lunch with engineering students
1-3 p.m.	Engineering class visits
3-4 p.m.	Closing session for parents

The consultant-facilitator guided the focus groups in three different ways: First, a one-hour parents' meeting was held in the late morning after open tours of the engineering labs. (The consultant assumed the role of facilitator rather than the department chair to assure frank responses and to maximize the free flow of ideas.) The consultant-facilitator asked the parents to talk about two things: to tell stories of their sons' or daughters' decision to choose engineering as a focus of study, and to describe and explain why they and/or their son or daughter chose this particular academic program. A scribe took notes while the parents talked.

Second, the consultant-facilitator asked the parents to facilitate a discussion with students during a group lunch. One parent per table of four students would solicit student reactions to a set of questions that were also listed on the students' written questionnaire. A second parent at the table agreed to write down the reactions and responses. The student questionnaires were collected after lunch. (Students were asked to not sit at the same lunch table as their parents to assure more frank responses to the questions.) The five questions that were asked of students on the questionnaire and at lunch conversations were:

1. Why did you come here (to this university; to this program)?
2. Why did you stay?
3. What do you think you are learning? (critical thinking)
4. How is your confidence level affected by this program? (confidence)
5. When you think about becoming part of a learning community, what does that mean to you? (lifelong learning)

A third way the facilitator guided the focus groups took place as the last activity of the parents campus visit late in the afternoon. This was a facilitator-led discussion that centered on the four questions on the parent's written questionnaire. The four questions that guided this closing discussion were:

1. Why did you come here today?
2. What are you seeing (impressions)?
3. What are the issues?
4. What's one thing you think we should do differently?

At this closing meeting time, two scribes took notes of the responses and discussion.

These two brief, written questionnaires had been designed to gather student or parent impressions of the program with a particular sensitivity for clues to lifelong learning and critical thinking. The student questionnaires were distributed at the student-parent lunch. A parent-facilitator introduced the questions casually into the general table talk of the occasion. The parent questionnaires had been distributed at the late morning focus group meeting of parents. The facilitator asked parents to use their four questions both to guide their awareness during the day visit and to use the questionnaire sheet to write down their responses to the questions. The parents were asked to bring them to the closing meeting in the late afternoon. If they were not able to be at the closing meeting, they were invited to send the questionnaires to the department at their earliest convenience as a way of assuring them that their reactions were important to the department and as a way of ensuring a larger response rate.

The consultant analyzed the collected data (completed written student and parent questionnaires, the scribes' notes of the parents morning meeting and the late afternoon meeting, and the consultant-facilitator's notes and captured recollections from the two meetings) for trends. Five completed student questionnaires were submitted reflecting summaries of each of the lunch table student-parent groups. Only four completed parent questionnaires were handed in from the 13 parents who participated in some or all of the campus visit day. (One was emailed one week later.) However, the four items on the parent questionnaire generated considerable verbal information that shaped the closing focus group discussion and was captured by the scribes and the consultant-facilitator.

Trends/Themes/Results/Findings from Year One –2000

Responses from both the student and parent questionnaires were revealing and positive, supporting both the general thrust of the academic program and the overall learning atmosphere of the department, and by implication, the university. Students chose the university and program because they perceived it to be smaller, more personal and less overwhelming than a large

university. They expected and actually encountered classes taught by doctoral level faculty, with a greater chance for individual attention. In addition, the liberal arts program and atmosphere was seen as a positive, as was tuition support. What they are gaining was more general than career-specific: to be a productive member of society, to manage their time and life, to learn how to solve problems, and to integrate their occupational learning with the liberal arts foundation. Students felt confident to take on the work after their degree because of internship and interviewing opportunities, and reported that they have greatly increased self-confidence during their time in the program. Some students felt supported by the learning environment and felt appropriately prodded to do their best. Others reported confidence that the program is solid and on the “right track” based on the perception of a world expert from another university, who also teaches as an adjunct faculty member in the program.

The two parent focus groups and four-item questionnaires yielded similar positive reactions as the student questionnaires regarding what the parents had experienced about the BSME program and the university in general. The theme of the before-lunch focus group was to gather parents’ impressions or stories as to why their son or daughter chose engineering as a field of study and why they chose to pursue that major at this university. They told stories of students who tended to make early career and academic choices during their high-school years. They told of students for whom academics were the mainstay of their college years. They also acknowledged a concern by the students that they be able to take advantage of a full college life and gain the benefits of the broad liberal arts experience, to find out “who I am as a person,” as one student told her parents. The small size of the campus with the presumption of close contact with faculty was deemed a crucial factor in choosing the university. One parent related that his daughter could have gone to MIT or some other prominent technical university but would have missed out on the liberal arts. Several noted that engineering seemed a natural applied area given their son’s/daughter’s inclination toward math and sciences in high school.

Parents found the invitation to be a good opportunity, of course, to visit with their daughter or son, and also to vicariously experience how their children experienced the program and school. One set of parents was curious as to why their son felt compelled to come to college after a successful ten-year career as a mechanic. Another set of parents wanted to find out what the attraction was that would make their daughter transfer from a highly regarded engineering college. The parents unanimously expressed satisfaction with the quality of the physical facilities and campus learning resources (e.g., networked computers across the campus). They also were gratified to see close working relationships between students and faculty as evidenced in their interactions on a first-name basis. That the faculty had extensive engineering and related professional practice experience was a major plus. As one father put it, “Faculty who can apply make better teachers because they’ve experienced their own failures along the way.” The school was perceived to have a solid academic reputation in bordering states, and that helped the parent feel confident of his son’s choice. The small size of the program allows for freshmen to talk with seniors and, by implication, students at other levels, encouraging students to learn from each other. Parents expressed a desire that more opportunities be created for student-to-student dialog.

Parents raised some issues. They wondered about the ease of access to advising about engineering-specific issues. Also, a concern that bachelor-level students were taking night courses that could lessen the students’ opportunity to take part in other undergraduate campus

activities that are geared for a daytime class schedule. Related to evening classes was the issue of safety at night. Reaction to having undergraduates in class with graduate students was mixed. One set of parents urged the department to gain ABET accreditation to assure the credibility of the degree for future alums. (In 2001, the BSME received EAC of ABET accreditation.) Finally, the discussion elucidated support from parents for broadening the engineering specialties in the future to include electrical, chemical, and civil engineering options. (The department subsequently secured all necessary approvals for a BSEE program and it began F2001 term.) No other specific recommendations emerged when the question of what could be done differently was raised.

These results were then discussed by the faculty at subsequent meetings. The faculty made recommendations for improvements that included, among other things, a proposal of a BSEE program to the university program committee and senate. The department planned to hold yearly visits as a result of this first attempt.

Year Two—2001

The purpose for conducting a second assessment was twofold: 1) to get a measure of current stakeholders' perceptions of the BSME program; and 2) to compare the findings of this assessment with the results of the earlier assessment conducted in April 2000 using the identical process. Unlike the 2000 assessment, no parent questionnaires were returned to the assessors, but four student questionnaires reflecting the lunchtime student focus group discussions were returned.

As in 2000, the perceptions and reactions of parents and students to UST in general and the BSME program in particular were positive about programming and facilities. Parents perceive that their children are very satisfied with the educational climate, and specifically cite the practical expertise the faculty brings to the learning process including career-related guidance. Also, because of the faculty's connections with the applied engineering world, the parents believe that the students get better access to that world via tours of facilities, guest speakers in the courses, and the potential for building a network of future advisors for the graduates of the program. When the parents were asked "What are you seeing?" as they visited classes as well in their more general impressions of development occurring in their children, a prominent observation was that students are unlearning the traditional competitive mindset and replacing it with a team-focused cooperative style of working with others. One of the parents, who is a nuclear engineer himself, applauded the department for helping to instill the awareness and skills of cooperative work habits in the students. Team projects were noted as a concrete example of how that "unlearning" was shaped. The parents also noted an overall positive attitude conveying what students can do, rather than what they can't. Students' increased self-confidence was evident in how students explained their work in the labs as well as in their classroom presentations.

Several parents commented that college should be the place where young people should learn how to deal with their own problems, to learn how to learn, and to become more "street smart *and* people smart." A concrete suggestion to help the personal development was to increase the department's efforts to encourage mentoring relationships between freshmen-sophomores and

juniors-seniors, especially to attempt to pair up students with diverse abilities. But, they did see a strong and easy camaraderie evident among students now.

A strong commitment to student development by faculty was evident to the parents, but three areas of concern were voiced.

- 1) There was some concern that engineering-focused advising does not happen soon enough in the students' careers. They recommend that freshmen who declare Engineering as their major be given an advisor who is savvy with the field and with the occupational specialties of engineers, though such advisors do not have to be a faculty member.
- 2) There was concern about the yearlong final project: was there sufficient and timely formative evaluation offered the students as they progressed through the project, and could that project have the option of being a teamed effort to further reinforce the cooperative nature of current engineering practice?
- 3) How can parents be assured that their children have access to and can locate the support resources from the campus that they need, e.g., counseling services, research support services.

An email newsletter was suggested as a way to help parents stay better informed about what is happening in the BSME program, and about resources available for their children. With current knowledge about the program in hand, they felt they could do a better job of guiding their child via phone and e-mail chats, home visits at break times, etc. They want to continue to be parents, in partnership with the faculty, to their emerging adult children.

Finally, one parent who herself is a professor at another university, urged the BSME faculty not to get too caught up in research and grant soliciting because of its potentially adverse impact on the strong faculty-student relationships that the BSME program has developed.

What drew students to the university? The promise (and reality) of small class sizes, especially for the courses of their major; the personal influence of faculty (especially of the chair, the "real-world professors" as one student noted) and the chance to work closely with them; and scholarship support from the university including the ROTC option.

Students stayed because of the relationships built with the faculty and other engineering students, the breadth of extracurricular activities that they could be involved in, and the summer research opportunity. Students feel that they are learning not only the field of engineering, but also time management, teamwork, and how to be responsible for their own learning. They have confidence that they will be employable when they leave the program because they perceive that how they are learning replicates how they will function when they get into the work world. The present relationship with faculty gives them confidence that they could continue to seek useful advice from their professors after they complete their degree—the continuation of a professional relationship that could be life long. As one student said, s/he was "proud to be an engineering student."

Conclusion

This round of qualitative assessment reinforced the positive messages from the previous year's assessment delivered to the department and to the university. No major change in methodology was suggested for 2002, however researchers are aware of the positive nature of parents' responses. The faculty and program were urged to stay the main course because "it's working." Where results indicate need for improvement (e.g. an email newsletter for communication with parents), action will be taken according to the continuous improvement plan.

Researchers believe parent focus groups are important not only for assessment purposes, but also for building relationships with important stakeholders. From this line of inquiry, a questionnaire could be generated to which a larger and more representative sample of students and parents could respond for more convincing data. A set of suggestions that generalize to other programs is also possible.

Appendix A: Continuous Improvement Plan

Level	Plan	Do	Check	Action
Voice of the Customer	Identify constituents and solicit their input	Develop program objectives	Assess effectiveness of process in light of the University Mission	Modify process and list of constituents based on assessment
Program	Develop assessment tools and standards for evaluating accomplishment of program objectives	Develop student outcomes that support accomplishment of program objectives	Assess accomplishment of program objectives and effectiveness of student outcomes in supporting objectives	Modify list of desired outcomes to better support program objectives
Curriculum	Develop assessment tools and standards for evaluating accomplishment of student outcomes	Develop list of required and elective courses, individual course learning objectives, and prerequisites	Assess effectiveness of curriculum in producing desired student outcomes	Modify curriculum, course learning objectives and prerequisites to better achieve learning outcomes
Course	Develop course material including assessment tools, standards, and resources	Offer course	Assess accomplishment of learning objectives	Modify course materials and activities to better accomplish objectives and provide feedback

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