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Engineering Faculty Perspectives on the Nature of Quality Teaching

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Quality Approaches in Higher Education

Understanding how faculty define quality teaching and identifying intrinsic barriers to adopting student-centered teaching.

Engineering Faculty Perspectives on the Nature of Quality Teaching

Jacqueline C. McNeil and Matthew W. Ohland

Abstract

There is wide agreement that teaching quality matters in higher education, but faculty have varied ideas about the definition of quality. Faculty definitions of quality teaching were coded using an existing framework. The most common definition of teaching quality (held by 49% of participants) is associated with elitism and restricted access—the best way to improve education is to admit better students. These faculty focus on education as "knowledge transfer" and "learning content." Another 38% of faculty had a transformational perspective, more focused on process than content, valuing "empowering students," "developing students," and "creating an environment for learning." These faculty refer to pedagogies of engagement such as active learning. The only other prevalent definition of quality (30% of faculty) focused on "fitness for purpose," characterized by terms such as "ability to meet specific legitimate learning objectives" and "mastery of learning outcomes." This work provides guidance to faculty development efforts.

Keywords

Professional Development, Teaching Methods, Faculty Development

Introduction

There have been multiple calls for change in higher education, and these changes are seeking more student-centered teaching practices: From Analysis to Action (NRC, 1996), Shaping the Future (NSF, 1996), and Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology (NRC, 1999). Research has shown that student-centered (nontraditional) teaching has advantages of higher retention, deeper learning, and student enjoyment (Astin, 1993; Cabrera, Nora, Bernal, Terenzini, & Pascarella, 1998; Cooper, 1990; Gamson, 1994; Goodsell, Maher, & Tinto, 1992; Kulik, Kulik, & Cohen, 1979; Levine & Levine, 1991; McKeachie, 1986; McKeachie, 1990; Murray, 1998; Pascarella & Terenzini, 1991; Prince, 2004). Engineering faculty are hindered from adopting student-centered teaching methods by intrinsic and extrinsic barriers (Borrego, Froyd, Henderson, Culter, & Prince, 2013; Prince, 2004; Riley, 2003; Smith, Douglas, & Cox, 2009; Smith, Sheppard, Johnson, & Johnson, 2005; Wankat & Oreovicz, 1993). A recent report showed that engineering faculty were the third lowest in higher education, at 45.5%, in asking students to think critically about the deeper meaning or significance of what they were learning (Eagan, Stolzenberg, Lozano, Aragon, Suchard, & Hurtado, 2014). This research explores the intrinsic barriers to adopting student-centered (nontraditional) teaching methods by asking faculty to define quality teaching.

The purpose of this study was to discover the nature of quality teaching within engineering faculty at a number of universities in the United States. A wide variety of stakeholders would likely agree that quality matters in higher education—but what does that mean? The definition of "quality" is likely to vary from person to person and even for the same person in different contexts. Measuring the quality of an automobile is different from measuring the quality of drinking water. Because engineering faculty are typical of other faculty in higher education in that they receive little, if any, formal training in teaching (Kenny, Thomas, Katkin, Lemming, Smith, Glaser, & Gross, 2001), the findings here should have relevance to other disciplines.

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This research will help faculty, faculty developers, administrators, students, and industry leaders understand the language used to describe quality teaching and the criteria faculty are using to define it. Thus, this paper leads to a deeper understanding of quality teaching in engineering education—an essential step in achieving it. Further, if there is diversity in how faculty define quality teaching, but the evaluation of teaching does not acknowledge that diversity, the result is that the success of some faculty who are striving for quality teaching will be measured against the wrong yardstick. As we strive for more diversity in engineering among students and faculty, and in the profession more generally (National Academy of Engineering, 2002), we must be transparent in how we measure success and be prepared to measure it in different forms.

Quality and Quality Management in Higher Education

Research on quality and quality management in industry have been applied toward designing a quality management system for higher education, with various papers on different topics within the umbrella term of quality (Srikanthan & Dalrymple, 2003). Owlia and Aspinwall (1996) created a framework for dimensions of quality specifically for colleges and universities by comparing nine different models of service quality dimensions. Each of the nine models that were compared showed how different perspectives can change the model's quality dimensions. Owlia and Aspinwall (1996) compiled these various quality dimensions into a set for higher education: tangibles, competence, attitude, content, delivery, and reliability. Even in these papers that address quality from an industrial management perspective, there is debate regarding how to assess the teacher-student interactions because envisioning a student as a metaphorical "output" of a manufacturing process is unpalatable. Another approach to measuring quality in higher education is based on methods of measuring quality in a service business, as this avoids the need to compare students to products that are developed and made in a factory (Owlia & Aspinwall, 1996).

The work of Garvin (1988) is more useful because he provides a five-faceted definition of quality: transcendent, product-based, user-based, manufacturing-based, and value-based. By encompassing diverse meanings of quality, we begin to be able to account for the different ways faculty achieve it. Transcendent interpretations of quality are individualistic, personal, and associated with ideas like love. Product-based interpretations are based on measurable standards. User-based interpretations address customer satisfaction criteria, which may vary considerably among stakeholder groups. Manufacturing-based interpretations are those that emphasize zero-defects based on manufacturer specifications. Value-based interpretations focus on economic benefit.

Harvey and Green (1993) adapted Garvin's definitions of quality in higher education resulting in five similar categories: exceptionality (in the sense of excellence), perfection and consistency, fitness for purpose, value for money, and transforming. These definitions, described below, regarding the nature of quality fit the data from how engineering faculty described quality teaching.

Harvey and Green's Model of Quality in Higher Education

Quality as Exceptionality

Exceptionality is accepted universally in higher education because it is so elite and rare (Pfeffer & Coote, 1991). This definition is pervasive in higher education because it is viewed as distinctive, special, or high class (Astin, 1993; Harvey & Green, 1993). Astin (1993) described the typical values behind excellence in education as reputation and resources, whereas he argued for "talent development," focused more directly on the basic purpose of higher education. In resources, Astin included money, high-quality faculty, and high-quality students. Astin described reputation as a pyramid with a few well-known universities on top and two-year community colleges and most smaller four-year universities on the bottom with no systematic research justifying an institution's position in the pyramid. This conflates quality with exclusivity, inaccessibility, and privilege. Higher education in general is thus granted a measure of quality simply because not all people participate. Thus, Astin (1993) describes an American folklore of reputation in higher education. Ball (1985) defined excellence as having high, almost unattainable, standards. Meeting such standards requires excellent inputs and outputs (Moodie, 1986), which would make access to higher education even more limited. Ironically, this focus on attracting exceptional students reduces the need for quality teaching—as Harvey and Green note, "It does not matter that teaching may be unexceptional—the knowledge is there, it can be assimilated" (1993, p. 12). This view of quality has been described in universities in Britain, Germany, and the United States (Astin & Solomon, 1981; Frackmann, 1991; Moodie, 1988; Miller, 1990).

Quality as Perfection and Consistency

Harvey and Green's (1993) description of perfection and consistency as quality is an educational translation of "zero defects" and "getting things right the first time." This form of quality is more inclusive because it is possible for all institutions to achieve it. An institution can demonstrate quality by meeting predefined measurable standards. The focus is on the process and conformance to specifications, rather than stressing inspection as a means to quality (Peters & Waterman, 1982). This echoes Deming's principle, "Cease dependence on inspection to achieve quality" (Deming, 1986) and more recently, the Accreditation Board for Engineering and Technology's (ABET) policy that "It is not necessary to assess the level of attainment of an outcome for every graduate. Similarly, it is not necessary to assess the level of attainment for an outcome every year. Appropriate statistical sampling procedures may be used in the assessment of outcomes and objectives" (ABET, 2014).

Quality as Fitness for Purpose

Fitness for purpose provides another approach to defining quality, which resonates with a desire to recognize a diversity of faculty goals and a diversity of institutional missions. While Harvey and Green (1993) define fitness for purpose as how well the service meets the expectations of the customer, there is no clear agreement on who the customers are in the case of higher education. Some customers who have been associated with higher education are students, parents, employers, and taxpayers (Jauch & Orwig, 1997; Mazelan, 1991; Collins, Cockburn, & MacRobert, 1990; Harvey & Green, 1993). In the case of higher education, there is also concern that customers are not in the best position to know what the specifications should be, particularly if the students are viewed as the customers (Marchese, 1991; Roberts & Higgins, 1992). If we consider the institutional mission as fitness for purpose, the institution can be judged by how effectively and efficiently it achieves its mission, based on the quality assurance mechanism the university has in place (Harvey & Green, 1993). Noting that an institution's mission and its quality assurance mechanism may not align with consumers and their view of quality, it is not surprising that student satisfaction may not align with other measures of quality (Sallis & Hingley, 1991).

Quality as Value for Money

This interpretation assumes that quality can be defined in economic terms. This approach levels the playing field of exceptionality by considering what an institution achieves based on the students it attracts and the resources it consumes. In higher education in the United States, research expenditures are one of the primary measures of quality (Jennings, 1989; Cross, Wiggins, & Hutchings, 1990; Hutchings & Marchese, 1990; Millard, 1991). Measures of efficiency may not be good measures of effectiveness (Yorke, 1991; Yorke, 1992). Sensicle (1991) points out that there may be a tendency to rely solely on performance indicators to measure quality, and writes, "important qualitative aspects of performance and progress in higher education might be missed or submerged" (p. 16). Harvey and Green (1993) suggested customer charters as a way to establish a set of standards of what a customer should expect for the money they pay, thus establishing a measure of quality. While such charters are intended to create a competitive market for higher quality, they have more commonly been used to set a standard practice for maintaining quality.

Quality as Transformation

Transformation is a change of form, which can be documented qualitatively, such as ice being transformed into water—while the temperature can be documented quantitatively; the change from solid to liquid is qualitative (Harvey & Green, 1993). In regard to education, the transformation process can be applied as doing something to the consumer, rather than doing something for the consumer (Elton, 1992). This transformational view of higher education even applies to the construction of new knowledge, because we are not just adding to the research, but are intertwined within the research we conduct (Kuhn, 2012; Price, 1963; Lakatos & Musgrave, 1970; Mullins & Mullins, 1973; Holten, 1988). Transformation might be achieved by enhancing or empowering the consumer. Enhancing the consumer can be related back to the inputs and outputs from the previous quality categories because with a value added, the conclusion would be to find a way to measure the value added, and perhaps miss the qualitative nature of quality added. Muller and Funnell (1992) argue for transformation in value added by explaining that learners should be participants in their own learning and evaluating processes. This is closely aligned with empowering the consumer, which involves giving power over to the consumer to transform (Harvey & Burrows, 1992). Empowering the student in higher education will give them a chance to make decisions about their own learning (Wiggins, 1990). This self-empowerment can lead to student evaluations, student charters, self-selecting classes, and their critical thinking ability (Harvey & Green, 1993). Critical thinking cannot be learned solely through traditional lectures: "This requires an approach to teaching and learning that goes beyond requiring students to learn a body of knowledge and be able to apply it analytically. Critical thinking is about encouraging students to challenge preconceptions; their own, their peers and their teachers" (Harvey & Green, 1993, p. 26). Quality in terms of transformation of students is seen as "the extent to which the education system transforms the conceptual ability and self-awareness of the student" (Harvey & Green, 1993, p. 26).

These definitions of the nature of quality in higher education provide a framework for interpreting open-ended responses of faculty defining quality teaching. By classifying engineering faculty based on their definitions of quality teaching, the researchers describe the conditions for change, and the conditions facing those who promote change, such as faculty development professionals.

Methods

This work builds on a survey administered to faculty at institutions in the Southeastern University and College for Engineering Education (SUCCEED) Coalition in 1997, 1999, and 2002 (Felder, Brent, Miller, Brawner, & Allen, 1998; Brawner, Felder, Brent, Miller, & Allen, 1999; Brawner, Felder, Allen, & Brent, 2001; Brawner, Felder, Allen, & Brent, 2001; Brawner, Felder, Allen, & Brent, 2002; Brawner, Felder, Brent, & Allen, 2004). Just as the 1999 and 2002 surveys included minor updates based on changes in educational technology since prior survey administrations, changes were made to update the 2014 survey to reflect current technology. To measure the influence of various other stakeholders on faculty teaching practice, questions were added to probe faculty perspectives on quality teaching and the effect of the accreditation process on teaching practice. To make the findings easier to generalize, additional institutions were invited to participate in the survey, even though there would be no historical data from those institutions.

As shown earlier, the survey response rates were generally around 10%. This was in spite of efforts to ensure a high response rate, such as having the survey invitation come from a credible source (Dillman, 2007), sending reminder messages to non-respondents (Dillman, 2007; Kaplowitz, Hadlock, & Levine, 2004), grouping like items together to decrease survey time (Cooper, Traugott, & Lamias, 2001), and motivating participants to continue by displaying a progress indicator, and by using branching to reduce overall survey length (Cooper, et al., 2001; Dillman, 2007). Even so, a low response rate was not surprising and was likely due to three reasons: the survey was distributed electronically (Dillman, 2007; Kaplowitz, Hadlock, & Levine, 2004), an incentive could not be offered (Bosnjak & Tuten, 2003; Church, 1993), and for concerns regarding assessment fatigue (OIRP, 2014).

This work focuses on findings from an open-ended question, "How do you define quality teaching?" and five follow-up questions that measure the influence on quality teaching of the ABET accreditation process, colleagues, department climate, promotion and tenure process, and personal commitment to students. These follow-up questions were measured on a Likert-type scale from 1 (extremely negatively) to 7 (extremely positively). The other notable addition to the survey was an open-ended question and multiple follow-up questions related to the influence of accreditation. The results from those questions are beyond the scope of this article.

The open-ended responses defining quality teaching provided the basis for a collective case study (Stake, 1998) of how faculty define quality and what influences that definition. Among 91 survey respondents, 82 provided definitions of quality teaching. The definitions were read multiple times, and each definition was associated with a particular definition of quality described by Harvey and Green (1993). While some responses included a combination of phrases that might be associated with multiple definitions, it was possible to associate all responses with a dominant definition.

Logistic regression was used to explore the extent to which the various influences determine a faculty member's definition of quality, and the Duncan-Waller test for multiple comparisons was used to examine the relative importance of the five influences. Correlations of the five influencing factors are also discussed.

The theoretical validation of this data (Walther et al., 2013), while limited by including participants only from large, public, research institutions, is supported by other modes of variation. The sample includes faculty of different ranks and classifications. The average amount of time teaching was 16 years, which indicates that we are not measuring novelty effects. Procedural validation was shown through the use of qualitative and quantitative data to triangulate the results. Further, the constant comparative method was used to ensure that the researchers maintained consistency in coding the definitions of quality teaching (Walther et al., 2013). While the one-way communication of an open-ended survey makes communicative validation impossible, this approach enhances process reliability through the use of a consistent survey message (Walther, Sochacka, & Kellam, 2013).

Results and Discussion

Survey Response Rates

The response rate for each university separated by faculty type is shown in Table 1. The response rates do not raise concerns of a bias by institution or faculty type, but do impose limitations on our ability to disaggregate by both variables simultaneously in our findings. Such an analysis is precluded by our low sample size in any event.

Table 1: Response Rates by Participating Institution and Faculty Type

	Tenure/tenure track	Non-tenure track
School	% reported	% reported
A	8%	6%
B	11%	12%
C	9%	6%
D	3%	8%
Average	8%	10%

Table 2 shows a response rate for women that is high compared to their representation among engineering faculty, which is not uncommon (Smith, 2008). Gender is the single greatest predictor of survey completion (Sax, Gilmartain, & Bryant, 2003). While overrepresentation of women faculty will bias attempts at model development, an oversampling of women faculty, though unintentional, is an asset to the collective case study.

Table 2: Gender Distribution of Response Rates by Participating Institution

School	Male	Female	Not Reported
A	63%	25%	13%
B	68%	32%	0%
C	71%	14%	14%
D	67%	33%	0%
Total:	67%	25%	8%

Responses spanned a range of faculty ranks, as shown in Table 3. Faculty who had not taught undergraduates in the past three years were not allowed to complete the survey. Respondents averaged 16 years as a faculty member, 13 of which were at their present institution. Respondents represented various disciplines, with mechanical engineering, electrical engineering, and civil engineering most represented. Disaggregation by discipline is not possible.

Table 3: Distribution of Responses by Faculty Rank

Rank	Percentage
Assistant Professor	17%
Associate Professor	26%
Professor	34%
Instructor/Lecturer	15%
Faculty of Practice	1%
Adjunct/Visiting (any rank)	2%
Emeritus/Retired	0%
Other	4%
Total:	100%

Quality as Exceptionality

Harvey and Green's definition of quality as exceptionality was the most common. Faculty adopting this definition articulated the passive role of students in various ways—most delineating the measure of quality teaching from the instructor's perspective rather than the student's as "the effectiveness by which the material taught is conveyed from instructor to student" (Subject 39) and "the ability to convey information to non-experts" (Subject 40). A more extreme expression of this instructor-centered paradigm overtly disregards the student experience as important: "class does not have to be 'fun' or even interesting…" (Subject 36). Nearly half (43%) of faculty had a definition of quality teaching that fit this category.

Quality as Transformation

Faculty who use this definition of quality teaching use developmental language, describing the changes students experience as enhancing and empowering them to transform (Harvey & Green, 1993). This was the second most prevalent definition of quality teaching, with 28% of faculty definitions fitting this category. Such faculty discourse also tended to focus on process rather than content, describing the importance of "empowering students," "developing students," and "creating an environment for learning," and referring to pedagogies of engagement such as "active learning." One faculty described this process focus as, "effectively engaging students in the work of the course and empowering them to take responsibility for their learning and the learning of their peers." (Subject 71). This shift in responsibility for learning to students and their peers can represent a loss of control for the faculty. Harvey and Burrows (1992, p. 3) write, "it embodies not just a loss of control over the structural organization or academic content of higher education; it is a loss of control over the intellectual processes." The tension involved in adopting a transformational definition was articulated by a faculty member who struggled "… to find a balance between two conflicting roles: that of a coach, and that of a judge/gatekeeper… to identify and emphasize conceptual material that is non-intuitive." (Subject 33).

Wiggins argues that "we have a moral obligation to disturb students intellectually. It is too easy nowadays, I think, to come to college and leave one's prejudices and deeper habits of mind and assumptions unexamined—and be left with the impression that assessment is merely another form of jumping through hoops or licensure in a technical trade" (1990, p. 20). Engineers need to know technical knowledge and be able to question deeper assumptions. Yet even among engineering faculty who adopted this definition, some expressed concerns that engineering has technical knowledge requirements and that giving up control of student learning may leave students without all the tools they need to be a successful engineer. Other faculty were committed to student transformation without reservation, contrasting their views with the dominant "exceptionality" approach: "A course should ideally develop in the student a new way of thinking or a new perspective/

lens into the world. Just exposure to new information or even a new skillset is not indicative of a high quality course." (Subject 38).

Quality as Fitness for Purpose

This definition was described by 24% of faculty, using terms such as "ability to meet specific legitimate learning objectives" and "mastery of learning outcomes." Faculty described learning objectives and outcomes more generally, such as, "establish clear learning outcomes for the course and providing meaningful learning opportunities that foster mastery of the outcomes" (Subject 84) and "students attain learning outcomes en masse..." (Subject 90). In those cases, it is unclear if those learning outcomes are chosen by individual faculty or the department, college, or university. Similarly, these general descriptions are unclear as to what those learning objectives are and whether certain outcomes are more important than others to the faculty member.

Although faculty did not generally name the specific learning objectives or outcomes tied to a course, some were more specific about the purpose of the learning outcomes. Some faculty identified the purpose as application to practice, such as "How well the students can retain knowledge in the future and how well students are able to apply what they've learned in the future" (Subject 42) and "teaching the topics which are important to the students' future success…" (Subject 66). Faculty that define quality teaching in consideration of the student's future attempt to frame quality from the perspective of the student. This is called "quality in perception" (Harvey & Green, 1993, p.20; Sallis & Hingley, 1991). The definitions of quality teaching that fit this category are vague and varied because there is uncertainty and variation in defining the "purpose" of higher education generally and in engineering particularly.

Quality as Perfection and Consistency

The definitions of quality teaching received in this study did not resonate with this "zero defects" category. One respondent stressed "clarity and consistency in grading procedures" (Subject 89), and was coded as having this definition. Srikanthan and Dalrymple (2003) focused on the stakeholders in higher education and expected that employees such as faculty and administrators would view quality in this category, but we do not find this to be the case in our sample.

Quality as Value for Money

No respondents specifically addressed financial value, return on investment, specific performance indicators, or student/teacher charters on criteria for teaching—all of which would fit this definition. One respondent was classified in this category who cited ABET as an external authority. Turning to an entity outside the university to set standards of quality is characteristic of this definition. This respondent's definition of quality teaching included "facilitating student learning of the specific technical and non-technical (includes ABET a-k) information and skills that apply to the course in question" (Subject 13).

Influences on Quality Teaching

Five possible influences—the ABET accreditation process, colleagues, department climate, the promotion and tenure process, and personal commitment to students—were studied for their relationship to a respondent's definition of quality using logistic regression. The follow-up questions were measured on a Likert-type scale from 1 (extremely negatively) to 7 (extremely positively). The definition of quality teaching was a categorical outcome variable and the five influences were independent variables. Neither gender nor faculty rank were found to play a role in a faculty member's definition of quality teaching or the nature or extent of influences on teaching quality, so those were removed from the model and are not discussed further. Table 4 shows the faculty's definition of teaching quality a space before the 20 coded as one of the five Harvey and Green's taxonomy and faculty's Likert scale questions of what influences their teaching quality.

Table 4: Means of Each of the Influences by Quality

Nature of Quality	ABET	Colleagues	Department Climate	Tenure and Promotion	Personal Commitment
None	4.1	5.5	5.1	3.8	6.4
Exceptional	3.9	5.1	4.6	3.9	6.6
Perfection	4.0	4.0	2.0	3.0	6.0
Fitness for purpose	4.6	5.7	5.1	3.8	6.7
Value for money	5.0	4.0	4.0	3.0	6.0
Transformational	4.0	5.6	4.8	4.0	6.7

Table 5: Means of Each of the Influences by Gender

Gender	ABET	Colleagues	Department Climate	Tenure and Promotion	Personal Commitment
Not reported	3.0	6.0	5.9	3.9	6.9
Male	4.1	5.3	4.5	3.8	6.6
Female	4.5	5.7	5.5	4.1	6.3

Table 6: Means of Each of the Influences by University

University	ABET	Colleagues	Department Climate	Tenure and Promotion	Personal Commitment
A	4.2	5.4	4.6	3.8	6.2
B	4.3	5.6	4.8	3.8	6.8
C	3.9	4.8	4.5	4.2	6.7
D	4.0	6.2	5.8	4.0	6.8

Table 7: Means of Each of the Influences by Rank

Rank	ABET	Colleagues	Department Climate	Tenure and Promotion	Personal Commitment
Assistant	4.0	5.2	4.8	3.8	6.6
Associate	4.2	5.3	4.5	3.9	6.5
Professor	3.9	5.4	4.8	3.8	6.7
Instructor	4.5	5.6	4.9	4.0	6.2

Only one influence was found to have a significant ($p \leq 0.05$) relationship to a respondent's definition of quality in Table 4. With an odds ratio of 1.745, an increase of one unit on the reported influence of ABET accreditation is associated with a respondent being 1.745 times more likely to define quality teaching as "fitness for purpose." Because engineering accreditation provides a standard set of outcomes for engineering graduates (a common purpose), but provides flexibility in how those outcomes are achieved, this relationship can be explained. The greater challenge is explaining why no other relationships were observed between a respondent's definition of quality teaching and the various influences. Whereas a faculty member's definition of quality teaching was generally independent of their reported influence of the five factors studied, a pattern was observed among respondents' reported influences—there appeared to be a consistent ranking of the influences as shown in Tables 5, 6, and 7. To control for the effect of comparing multiple means, the Duncan-Waller test for multiple comparisons was used, and the results are shown in Table 8. All the means are significantly different, except the ABET accreditation process and the promotion and tenure process.

Table 8: Duncan-Waller Test for Multiple Comparisons of Influences on Teaching Quality

Duncan Grouping	Mean	Influence
A	6.6	Personal commitment to students
B	5.4	Colleagues
C	4.8	Departmental climate
	4.1	ABET accreditation
D	3.8	The promotion and tenure process

Note: Means with the same letter are not significantly different (p=0.05), N=90 or 91.

Personal commitment to students has significantly more reported influence than colleagues, who have significantly more reported influence than the departmental climate, which, in turn, has significantly more reported influence than ABET accreditation and the promotion and tenure process. The promotion and tenure process is a ritual that formalizes some aspects of the department climate, but respondents draw a distinction between the two. In other words, colleagues and the department can communicate values and practices related to quality teaching that are not embodied in the promotion and tenure process—policies are slower to change than people.

It is discouraging to note that the average influence of the promotion and tenure process is negative. Based on the open-ended responses of faculty, the focus of that process on research grants and publications at these universities has a negative effect on faculty's teaching quality.

The ranking of the five influences studied was robust—the ranking was the same regardless of gender, faculty rank, and university. This has implications for faculty development practices. The strong influence of colleagues may at first appear as a barrier to change—because even if a department has expectations regarding quality teaching (such as by requiring faculty to attend teaching workshops), a junior faculty member may reduce her or his commitment to quality teaching based on conversations with colleagues. Yet this influence represents an opportunity as well—this underscores the potential for positive influence through mentoring by colleagues—particularly where a teaching mentor is identified independently from a research mentor. Pairing senior and junior colleagues as they engage in faculty development related to teaching may also prove effective.

One university had a notably higher rating for the influence of the promotion and tenure process, so there is hope that a university's policies on promotion and tenure can have a positive effect on faculty's teaching quality. Respondents at that university also indicated a higher influence from colleagues (p=0.05, odds ratio = 0.37), so all other things being equal, respondents at that university rate the influence of colleagues 0.37 higher on average than at other universities in the sample.

Based on the consistency of the rank order of the five influences, it is not surprising that responses for some of the influences are significantly correlated. Specifically, there is a relationship between the influence of colleagues and department climate (r=0.67, p<0.01), department climate and the promotion and tenure process (r=0.33, p<0.01), and colleagues and personal commitment to students (r=0.28, p<0.05). These correlations neither provide additional insight nor diminish the meaningfulness of the earlier results.

Responses to "ABET accreditation process" as an influence in teaching quality are unrelated to gender, total years as a professor, and institution. Using "extremely negatively" (1) as the referent, faculty who responded more positively were less likely to "give students the option of working in teams (two or more) to complete homework" [b = -0.41, χ^2 (1, N = 89) = 6.24, p < 0.05 (odds ratio = 0.665)]. This is an interesting finding, since ABET accreditation wants students to be able to work in teams as an outcome. This research has shown that faculty with a nature of quality of fitness for purpose are more likely to see the benefit of ABET accreditation standards, perhaps these faculty are focused on fitness for purpose, and do not see the purpose in giving students the option of working in teams. Responses to "colleagues" as an influence in teaching quality are unrelated to gender, total years as a professor, and institution. Using "somewhat negative" (2) as the referent group because none of the participants chose the lowest response, faculty who responded more positively were more likely to "require students to work in teams (two or more) to complete homework" [b = 0.36, χ^2 (1, N = 89) = 4.26, p < 0.05 (odds ratio = 1.429)].

"Department climate" responses as an influence in teaching quality are unrelated to gender, total years as a professor, and institution. Using "extremely negatively" (1) as the referent group, faculty who responded more positively were more likely to "require students to work in teams (two or more) to complete homework" [b = 0.40, χ^2 (1, N = 88) = 5.42, p < 0.05 (odds ratio = 1.488)].

The influencers of "promotion and tenure process" and "personal commitment to students" did not have any significant relationship to teaching methods.

Conclusions

Engineering faculty do not have a common understanding of quality teaching, nor were all anticipated definitions present. Faculty developers and department chairs must consider these different definitions of quality teaching to reach diverse faculty. Faculty whose definition of quality teaching resonates with accreditation may be well-suited to explaining the accreditation process to colleagues and in sharing accomplishments with accrediting bodies. This is especially important in that faculty who view quality as exceptionality are likely to view accreditation processes as a waste of time and money. Department chairs and upper administration may also be interested in faculty who view the nature of quality as transformational because those faculty are more likely to use student-centered teaching techniques, which bolster recruitment and retention (Astin, 1993; Cabrera, Nora, Bernal, Terenzini, & Pascarella, 1998; Cooper, 1990; Gamson, 1994; Goodsell, 1992; Johnson, Johnson, & Smith, 1991; Kulik, Kulik, & Cohen, 1979; Levine & Levine, 1991; McKeachie, 1986; McKeachie, 1990; Murray, 1998; Pascarella & Terenzini, 1991; Prince, 2004). These faculty may be best suited to "master teacher" roles.

Faculty developers should address the specific needs of faculty with an exceptionality view of quality teaching by explaining the research on how students learn and the best teaching practices from that research. Faculty with the transformative value of quality teaching could use more focused training on specific teaching methods. The fitness for purpose faculty could use a combination of an explanation of the research, which would show the purpose of specific teaching methods, and then a how-to workshop on student-centered teaching methods.

Future research on how faculty express personal commitment to teaching quality would likely reveal further underlying beliefs about teaching quality. The faculty surveyed reported that "myself" as the most important influencer of their teaching quality, which suggests that interview methods are an appropriate approach to probe how faculty think about quality teaching and how that thinking affects their pedagogical choices. There should be further exploration of the five different aspects of quality teaching within departments to see if they are recognized and addressed or ignored. Faculty with certain perspectives may not have a voice in their department. Another important question is how departments that have diverse views on the nature of teaching quality are perceived differently by the students in those departments and whether those differences result in varying student outcomes.

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