Obstacles to Instructional Innovation According to College Science and Mathematics Faculty

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Abstract: Numerous studies have documented the infrequent use of learner-centered instruction in college science and mathematics classrooms and its negative effects on undergraduate learning and motivation. The present research deepened understanding of why. Specifically, an Internet survey was constructed that explored obstacles, supports, and incentives for instructional innovation in the classroom and was sent out to college science and mathematics faculty of Louisiana. Results revealed that colleges generally were perceived to assign little or an indeterminate weight to instruction in personnel decision making. Faculty members generally have little training in pedagogy; but when they do, they are more likely to consult sources of instructional innovation and consider teaching an important part of their professional identities. Data concerning the most common sources of instructional innovation information are presented. Several suggestions are made for institutional reform that if enacted might contribute to systemic improvement in the quality of instruction undergraduates receive. © 2006 Wiley Periodicals, Inc. J Res Sci Teach 44: 85–106, 2007

Several reports over the last decade or so have revealed that college science and mathematics faculty seldom teach undergraduate classes in ways that promote student construction of knowledge, one effect of which has been to reduce the number of students majoring in science (Kardash & Wallace, 2001; National Science Foundation, 1996; Pearson & Fechter, 1994; Seymour & Hewitt, 1997; Siebert & McIntosh, 2001; Strenta, Elliott, Adair, Matier, & Scott, 1994; Walczyk & Ramsey, 2003). The National Science Foundation (NSF) has taken the lead in trying to reverse this trend and the generally poor performance of American students in tests of scientific reasoning compared to students of other industrialized countries. Starting in 1993, NSF's *Collaborative for Excellence in the Preparation of Teachers* (CEPT) provided funds for improving how undergraduate students are taught, especially those preparing to become elementary or secondary teachers (National Science Foundation, 1999). CEPT has been renamed STEM (Science, Technology, Engineering, & Mathematics) education. STEM sought to promote

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more meaningful and enjoyable learning in college students by helping college faculty to innovate in the classroom. Even so, it was understood that systemic changes in the culture of undergraduate education must occur before large-scale and abiding improvements in undergraduate science education could be realized.

Seventeen states have received STEM awards to implement system-wide changes in the culture of undergraduate instruction in science and mathematics. One highly successful grant was made to the *Maryland Collaborative for Teacher Preparation* (MCTP). MCTP's vision of constructivist teaching, which will be labeled hereafter *learner-centered instruction*, involves several elements (Fey, 2003). The instruction of undergraduate science and mathematics students should combine outside experiences, hands-on learning, group discussion, collaborative learning, and experimentation, with interpretation and sharing of the results. Students must acquire a conceptual framework for organizing and applying what they have learned. Assessments should be authentic, ongoing, diverse, and be capable of uncovering student misconceptions. These elements share in common the goal of promoting student construction of knowledge. To attain these and other features of learner-centered instruction, MCTP offered reformed content and pedagogy courses, science and mathematics research internships, field experiences under trained mentors, and supports for K–12 teachers once they entered the workplace (Fey, 2003).

McGinnis and colleagues were responsible for assessing the effectiveness of MCTP's efforts (McGinnis, 2002). A variety of survey instruments were administered both during and following teacher-candidates' participation in MCTP programs. Multiple findings confirmed their success. For instance, as a result of their participation, MCTP college instructors tended to model learner-centered instruction that connected to students' precollege experiences through classroom discussion and engaging classroom activities. Faculty used cooperative learning and manipulatives. Among the positive effects of this instruction on teacher candidates was that their attitudes moved in the desired directions (e.g., away from the belief that science is merely a collection of facts) the longer they participated. They also became more accepting of standard-based science instruction, more confident in their abilities to teach from this perspective, and less likely to be prescriptive in their beliefs regarding what their students must know.

Another highly successful grant was made to the *Arizona Collaborative for Excellence in the Preparation of Teachers* (ACEPT). Starting in 1995, Arizona State University and 11 community colleges of Arizona committed to long-term systemic reforms beyond the 5 years of the grant (Wyckoff, 2001). The overarching goal of ACEPT was to improve the learner-centeredness of science and mathematics instruction that future elementary and secondary educators receive, who would then hopefully teach future K–12 students in a like fashion. Science and mathematics professors attended month-long summer workshops in which they acquired learner-centered teaching methods. Courses, such as introductory biology, were redesigned to emphasize hands-on reasoning and collaborative learning, some producing 41% gains in scientific reasoning. Despite such impressive results, Wyckoff warned that acquiring learner-centered teaching practices can take faculty years to master. Furthermore, getting all science and mathematics faculty on board as willing participants might take a decade or so. Among other institutional reforms that will be necessary, she argued that "the faculty reward structure must also be reformed to sustain effective teaching" (p. 312).

The Present Study

Research on MCTP, ACEPT, and other STEM education projects has demonstrated the effectiveness of NSF's systemic reforms on improving the quality of instruction that science and mathematics teacher candidates receive. Moreover, such projects have highlighted many aspects of the culture of undergraduate science teaching that will have to change (Bell & Denniston, 2002; Wyckoff, 2001). The present research was funded by the *Louisiana Collaborative for Excellence in the Preparation of Teachers* (LaCEPT; see Walczyk & Ramsey, 2003, for a discussion of all of its programs). Based on an Internet survey, Walczyk and Ramsey (2003) demonstrated that learner-centered instruction was infrequently used in the undergraduate science and mathematics classrooms of Louisiana. In particular, they found that planning for instruction rarely involved the use of constructivist teaching methods. Lecture and recitation were predominantly used. Finally, traditional assessments such as multiple choice and essay tests were common measures of achievement. Rarely were authentic assessments such as peer evaluation or observational assessments used. The present study was a follow-up, the purpose of which was to identify some of the institutional roadblocks in the way of the use of learner-centered instruction according to the science and mathematics faculty teaching the classes. To this end, a new instrument was developed, the *Incentives and Supports for Instructional Innovation Survey* (ISIIS) and was sent to all science and mathematics professors of Louisiana who were accessible over the Internet. The ISIIS allowed us to ascertain from the instructors' point of view specific obstacles to instructional innovation and thus might help provide the necessary data with which to understand possible reasons for the infrequent use of learner-centered instruction. The present research was conducted approximately 1 year after the Walczyk and Ramsey study. The literature that follows was consulted in constructing the ISIIS.

In a 1999 report, the National Research Council (NRC) discussed modifications that must occur at American colleges and universities to move undergraduate education in science and mathematics in learner-centered directions. The NRC's vision for undergraduate instruction is that "Institutions of higher education should provide diverse opportunities for all undergraduates to study science, mathematics, engineering, and technology as practiced by scientists and engineers, and as early in their academic careers as possible" (p. 1). The NRC made several recommendations for systemic changes in the culture of undergraduate education that might realize this vision. Administrators (e.g., department heads, deans, academic vice presidents) should create incentives for faculty to develop innovative and interdisciplinary courses, to collaborate with parties outside the institution, and to develop engaging ways of teaching and assessing undergraduate science and mathematics courses. Instructional innovation should be required for promotion, tenure, and posttenure review. The NRC further recommended that faculty be hired with backgrounds in science teaching to serve as mentors for colleagues. Institutional learning centers, cross-department teaching workshops, teaching grants and awards, and support of educational technology all should be in place. Finally, science and mathematics doctoral students should receive formal training in learner-centered instruction.

The NCR (1999) also made recommendations for improvement under the control of faculty. Faculty should teach from a learner-centered perspective, which includes promoting understanding of fundamental concepts, involving students in hands-on and collaborative learning activities, and so forth. Given that many science instructors do not teach in this manner, we reviewed the NRC's recommendations for those that might account for the reasons why faculty members do not. Assuming that they may be unaware of the need for instructional innovation or unaware of the sources of instructional innovation information, the following recommendations seemed most relevant: Share with colleagues course syllabi, exams, and other sources of instructional innovation information; team-teach courses, especially with colleagues from other disciplines; attend local workshops; learn from colleagues recognized as excellent teachers; engage in scholarly activities concerning how students learn and effective teaching strategies within their disciplines; and consult the Internet for instructional innovation information.

Baiocco and DeWaters (1998) suggested the following as likely sources of faculty indifference to classroom innovation: minimal faculty training in pedagogy, minimal or ineffective institutional faculty development centers, minimal tangible supports for instructional innovation, difficulty in assessing teacher effectiveness, and minimal institutional rewards for teaching effectiveness in decisions of contract renewal, tenure, promotion, and raises. Regarding the latter, Marsh and Hattie (2002) noted that faculty at top research institutions are unlikely to view instructional innovation as a wise expenditure of their professional time, a view echoed by Harwood (2003).

Wright and Sunal (2004) recently summarized the results of surveys of science, mathematics, and technology faculty from 30 institutions of higher learning taking part in national professional-development projects. Surveys concerned perceived barriers to instructional innovation. Nine obstacles to achieving and sustaining learner-centered instruction in college science classrooms were identified. *Management* within institutions of higher learning may not support innovation in terms of funding summer grants, allowing reassign time for instructional innovation, and so forth. *Coordination* across departments and colleges may not be adequate. In other words, turf wars and other cooperation failures may erupt. The *leaders* of committees overseeing innovation may not be well respected throughout the institution and thus may be ineffective. *Faculty* may not be brought on board as willing participants through rewards systems, tangible supports, and so forth. *Students* may not be willing to accept innovations or may not be supported in doing so. The *curriculum* may not be modified sufficiently to support learner-centered instruction. Faculty *instruction* may not change enough or be sustained through ongoing workshops, summer programs, and the like. Sufficient *budget* allocations may not be adequate to support training, technology, and assessment. Finally, changes may not meet state and national *accreditation and certification standards*. Research is minimal that directly tests the aforementioned conjectures concerning barriers to learner-centered instruction. The ISIIS incorporates many of the potential obstacles identified by Baiocco and DeWaters (1998), the NRC (1999), Wright and Sunal (2004), and Wyckoff (2001), especially those directly impacting faculty.

Based on the preceding review of the literature, four major issues were investigated herein concerning barriers to instructional innovation among college science and mathematics faculty. One methodological problem with the data summarized by Wright and Sunal (2004) is that it came from instructors participating in national reform projects, who may have come from institutions more supportive of instructional innovation than is typical. In the present research, on the other hand, all science and mathematics professor of Louisiana accessible on the Internet were surveyed to determine whether many of the nine obstacles and the other barriers discussed earlier are perceived obstacles according to the faculty teaching the courses. For example, five of the road-blocks (management, faculty, budget, students, and curriculum) of Wright and Sunal were testable in the issues raised next, the primary focus of this research.

- Issue 1: How much weight is perceived by instructors to be assigned to teaching effectiveness by institutions of higher learning when making the personnel decisions of tenure, promotions, and raises (management, faculty, budget)?
- Issue 2: How frequently are nontraditional assessments (other than student ratings and open-ended comments) perceived to be used by institutions of higher learning to assess teaching effectiveness (management, students, curriculum)?
- Issue 3: How often have science and mathematics faculty received formal training in pedagogy (faculty)?
- Issue 4: When institutions are perceived to place greater weight on teaching effectiveness in making personnel decisions, are faculty members at those institutions more likely to be committed to instructional innovation information (e.g., have more positive attitudes about teaching, consult sources of instructional innovation more often) (management, faculty, curriculum)?

Methods

Participants

Target Population. The population of interest was all full-time biology, chemistry, Earth science, physics, science methods, mathematics, and mathematics methods faculty at 4-year colleges and universities of Louisiana, the same population that Walczyk and Ramsey (2003) had sampled 1 year earlier. The latter investigators had compiled a list of instructor e-mail addresses by visiting departmental Web pages online or calling departments. This list was used for the present research, but was updated to take account of faculty who retired, had left their institutions, had been recently hired, and so forth; 825 e-mail addresses were obtained and compiled into a Microsoft Excel file.

Sample. Of the 825 surveys sent out over the Internet; 4% bounced back (i.e., were sent to faculty addresses that were invalid); 235 completed surveys were eventually returned, a number surprisingly close to that of Walczyk and Ramsey (2003). We suspect that many of the respondents overlapped with those who had responded before. A response of 28.48% is higher than is typical for surveys involving traditional mailings (Churchill, 1979). A complete list of the institutions involved appears in Appendix A (see Item 1). To the right of each institutional name and bracketed is the number of faculty who returned surveys. The sample's racial composition was 88.5% Caucasian, 4.3% Asian, 3.0% African American, 2% Latino American, and 2.2% other; 67.2% were male, and 32.8 were female. The distribution by discipline was Biology: 63 (26.81%), Chemistry: 46 (19.57%), Earth Science: 25 (10.64%), Physics: 18 (7.66%), Science Methods: 4 (1.70%), Mathematics: 62 (26.38%), Math Methods: 8 (3.40%), and Other: 9 (3.83%). The distribution of academic rank was 17.4% instructor, 22.1% assistant professor, 23.8% associate professor, 36.2% full professor, and .5% other. Of the respondents, 62.1% were tenured, 23.4% were in a tenure track, and 14.5% were in neither.

Incentives and Supports for Instructional Innovation Survey

Survey Development. Walczyk and Ramsey (2003) developed an instrument (the SIAS [Survey of Instruction and Assessment Strategies]) to assess the use of learner-centered instructional methods among science and mathematics faculty. The ISIIS instrument described herein was developed for an entirely different purpose: to uncover potential institutional roadblocks to faculty innovation in the classroom. Relevant educational resources and databases (e.g., ERIC, *Buros Mental Measurements Yearbook*) were searched to locate an existent survey assessing obstacles to, incentives for, supports of, and attitudes regarding instructional innovation in college. Because none could be found, the ISIIS was developed by the authors. The instrument appears in Appendix A and consists of 42 items. Items 1 through 9 were adapted from Walczyk and Ramsey, and elicit demographic and other general information involving mutually exclusive categories (e.g., race, gender). All remaining items are new to this research. Items 10 through 26 concern faculty use of common sources of instructional innovation information, most of which were suggested by Chickering and Gamson (1999), the NRC (1999), Uno (1999), or Wyckoff (2001). Sources include students, colleagues, publications, workshops, and the Internet. Partly as a validity check of the adequacy of item coverage of possible sources, respondents had the option of specifying other sources of instructional innovation information.

Items 27 through 29 concern the weight assigned to teaching effectiveness in important personnel decisions. Item 30 addresses data sources used by administrators to assess teaching effectiveness. Also partly as a validity check, an open-ended ‘‘other’’ category was included. Items 31 through 33 assess the supports for instructional innovation available to faculty at their institutions, those that have been accessed, and those that are sought or should be maintained. Many supports identified by Biaocco and DeWaters (1998), the NRC (1999), Wright and Sunal (2004), and Wyckoff (2001) were included. Once again, respondents were allowed to specify others.

Finally, Items 34 through 42 (except for Item 38) assess faculty attitudes toward teaching. Using Likert items, respondents were asked how strongly they agree/disagree with the statements made. Items were reverse scored to minimize response-set bias (see Thorndike, 1997).

To assure the content validity of the SIAS, copies were reviewed by 10 experienced (i.e., tenured) science and math faculty at the institution sponsoring the research. Feedback involved clarifying educational jargon, disambiguating wording, minimizing redundancy, and adding items to ensure adequate coverage of the categories surveyed.

Procedure

The ISIIS was programmed into a standard Web-based HTML and sent out over the Internet during the regular 9-month academic year and sent again exactly 2 weeks later. To maximize response rate, potential participants were informed that results would be kept strictly confidential and that a letter commending their participation would be sent to their administrators at their request. By 1 month after the second e-mail, no more responses were received.

Results

Data Entry

The Web-based HTML returned to investigators ASCII files containing responses to each item that were then read into SPSS for Windows (SPSS, 1998), a statistical analysis program that ran on an IBM-compatible desktop computer. There were less than 8% missing data for each item. An α of .05 was used for all inferential statistical tests.

Analyses

Issue 1: How much weight is perceived by instructors to be assigned to teaching effectiveness by institutions of higher learning when making the personnel decisions of tenure, promotion, and raises? Table 1 conveys faculty perceptions regarding the weights assigned to teaching effectiveness in decisions of tenure, promotion, and raises for the entire sample. Approximately 25% of respondents were either at schools that had no set policy or at schools that failed to communicate to their faculty the weight assigned to teaching in important personnel decisions. Among those reporting weights assigned to teaching, a majority indicated that it was below 50%. Considerations of teaching effectiveness were generally assigned little weight or an indeterminate weight in important personnel decisions.

Issue 2: How frequently are nontraditional or long-term measures perceived to be used by institutions of higher learning to assess teaching effectiveness? The options of Item 30 appeared to capture most of the data sources used for assessing teaching effectiveness. Less than 2% of

Table 1
Percentage of respondents reporting specific weights given to teaching effectiveness in important personnel decisions

Weight Assigned to Teaching for	0%	1–25%	26–50%	51–75%	76–100%	No Policy	Do Not Know
Tenure	5.1	19.7	34.2	12.0	2.6	6.8	19.7
Promotion	5.5	24.3	30.6	10.7	1.3	6.4	20.4
Raises	9.9	20.7	26.7	6.5	1.7	8.2	26.3

respondents provided other data sources. Table 2 ranks the percentage of cases in which data sources were routinely reviewed to assess teaching effectiveness. Those used to evaluate a majority of faculty were student ratings, teaching awards, open-ended student comments, and evidence of instructional innovation. The use of nontraditional and long-term measures such as student interviews, student portfolios, or student success postgraduation was in the minority.

Issue 3: How often have science and mathematics faculty received formal training in pedagogy? Mean agreement with Item 38 concerning how much formal training faculty had received in pedagogy while in graduate school was 3.96 ($SD = 1.31$). Recalling that higher Likert ratings (close to 5) indicate greater disagreement, it is clear that a minority of faculty received formal training in pedagogy while in graduate school; 71% of the respondents reported a 4 or a 5.

Issue 4: When institutions are perceived to place greater weight on teaching effectiveness in making personnel decisions, are faculty members at these institutions more likely to be committed to instructional innovation? Preliminary to addressing Issue 4, factor analysis was used to simplify the data concerning the sources of instructional innovation information that faculty accessed. Responses to Items 10 through 25 were relevant. Items 10, 11, 13, and 21 to 25 are estimates of the number of times during the last calendar year that a source was consulted. Ceiling effects were not a concern. In each case, the option "8 or more" was selected by respondents less than 3% of the time. Items 12, 15 to 17, and 19 provided ranges rather than discreet values. The expected value (estimated mean) of each was determined by summing the product of the median of each range (e.g., 3 for the range 1–5) with the proportion that selected it

Table 2
Percentage of respondents reporting that the data sources below are routinely reviewed to assess teaching effectiveness

Option	%Answering Affirmatively
Student ratings	99.1
Teaching awards received	68.6
Open-ended student comments	68.4
Evidence of instructional innovation	55.1
Course syllabi	46.0
Classroom observations	41.4
Student success after graduation	27.3
Attendance at educational workshops	27.1
Student interviews	17.0
Student portfolios	3.4
Other	<2.0

[$\Sigma X \cdot p(X)$; Hays, 1994] for each item. Table 3 provides the observed means, observed *SD*s, and estimated means. By far, discussion with colleagues was the main source of instructional innovation information, followed by publications.

Common Factor Analysis (CFA) was performed, followed by a Varimax orthogonal rotation. CFA simplifies a dataset by combining items that are highly intercorrelated (i.e., aggregate items that may be measuring the same construct) into a single variable called *factor scores*. Factor scores then serve as the level of that latent variable for each respondent in subsequent analyses. CFA is superior to a principal components solution when analyzing survey data because it examines only the reliable variance among items and thereby adjusts for measurement error when estimating factor scores (Snook & Gorsuch, 1989). Factors with eigenvalues greater than 1 and variables with loadings with an absolute value of .4 or more were interpreted per convention (see Hair, Anderson, Tatham, & Black, 1995). Factor scores were retained. Factor loadings and the percentage of variance of the correlation matrix accounted for by each factor appear in Table 4. Survey items that loaded on the same factor are grouped together. Three factors emerged. The largest clearly concerned items tapping *consulting external authorities*, including books, articles, professional organizations, and workshops outside the home institution. The second largest factor involved *consulting others*. Experimentation in the classroom, formal and information input from students, and observation of and discussion with colleagues apply. Viewing of television does so as well, albeit indirectly. Labeled *consulting internal authority*, a third factor involved participation in workshops at the home institution and the use of the institutional faculty-development center.

Also preliminary to addressing Issue 4, survey items tapping faculty attitudes toward teaching duties (Items 34–42) were factor analyzed to uncover their latent structure. Once again, CFA was followed by a Varimax rotation. Three factors emerged. Means, *SD*s, and loadings of the Likert items appear in Table 5. Smaller means indicate greater agreement. Most respondents viewed their teaching duties as an important part of their professional identity, requiring more than merely conveying information. The largest factor included items suggestive that *teaching is important*. The negative loading of Item 39 was consistent with this interpretation. Items 36 and 40 loaded on the second factor, suggestive of a commitment to *innovative teaching*. The fact that Item 42, involving experimentation in the classroom, loaded positively, and Item 35 loaded negatively supports this interpretation. A single item loaded on a third factor related to having received *training in teaching* as a graduate student.

Table 3
Mean frequency that sources of instructional innovation have been consulted in the past year

Source	*M*	*SD*
Discussions with colleagues	7.22[a]	—
Publications	5.70[a]	—
Experimentation (trial & error)	4.42	2.57
Internet	4.10	3.10
Informal input from students	4.05	3.06
Formal input from students	2.94	2.16
Professional organizations	1.65	2.32
Observation of colleagues	1.23	1.88
Faculty development center	.91	1.65
Television	.84	1.77
Workshops at your institution[b]	2.92[a]	—
Workshops at other institutions[b]	2.79[a]	—

[a]Estimated mean.
[b]Over the past 5 calendar years.

Table 4
Item loadings on factors tapping sources of instructional innovation

Survey Item	Consulting External Authorities	Consulting Others	Consulting Internal Authorities
Possession of periodicals	*.74*	.01	.21
Possession of books	*.68*	.12	.13
Consultation of publications	*.66*	.23	−.01
Workshops outside home institution	*.62*	.11	.39
Professional organizations	*.59*	.30	.27
Trial & error	.11	*.67*	−.01
Formal input from students	.15	*.55*	.14
Discussion with colleagues	.09	*.55*	.03
Informal input from students	.08	*.53*	.13
Observation of colleagues	.36	*.49*	.04
Viewing television	.05	*.47*	.13
Workshop at home institution	.17	.09	*.95*
Faculty development center	.30	.22	*.52*
%variance accounted for	18.79	15.49	10.85

Note. Italicized loadings were interpreted.

Finally, the weights assigned by institutions to decisions of tenure, promotion, and raises were translated into ordinal variables as follows. Excluding data of respondents who reported that no policy existed or was unknown, Items 27 through 29 were summarized with the median of each interval. When a weight of "none" was reported, 0 was assigned to the ordinal variable. Otherwise, a 13, 38, 63, or 88 was assigned as follows. If respondents specified that the weight was between 1 and 25%, a value of 13 was assigned, and so forth. Two additional ordinal variables were similarly created for respondents' promotion and raise weights. To address Issue 4, Pearson product–moment correlations were calculated between the three ordinal variables and factor scores tapping respondents' access of sources of instructional innovation information and attitudes toward teaching (see Table 6). Factor scores larger in magnitude on instructional information access correspond to faculty who access sources of instructional innovation information more frequently. There is a slight tendency for faculty at institutions placing greater

Table 5
Means, SDs, and factor loadings of faculty perceptions of teaching

Survey Item	*M*	*SD*	Loadings for Teaching is Important	Loadings for Innovative Teaching	Loadings for Training in Teaching
37 Instruction crucial to my success	2.33	1.18	*.79*	.06	.11
34 Strong expectation for instruction	2.09	1.07	*.65*	.09	.00
39 Research more important than teaching	2.57	1.36	*−.56*	.12	−.25
41 Mentors support my instructional improvement	3.04	1.38	*.43*	.12	.39
36 Instruction major component of job	1.47	.83	.37	*.49*	−.04
40 My duty to encourage critical thinking	1.51	.74	.08	*.45*	.12
35 My job just to provide information	4.43	.93	−.01	−.41	−.05
42 Classroom experimentation is important	2.36	.96	−.08	.40	.33
38 Trained in teaching in graduate school	3.96	1.31	.11	.05	.42
%variance accounted for by factor			21.06	8.18	4.05

Note. Italicized loadings were interpreted.

Table 6
Correlations between the weight assigned to teaching in personnel decisions and faculty concern with teaching

	Tenure	Weights Assigned to Promotion	Raises
Consulting			
External authorities	.17(157)*	.16(156)*	.32(140)**
Others	.04(157)	.06(156)	.10(140)
Internal authorities	−.04(157)	−.06(156)	.02(140)
Attitudes toward instruction			
Teaching is important	−.51(169)**	−.52(168)**	−.43(149)**
Innovative teaching	.03(169)	.05(168)	.00(149)
Training in teaching	−.12(169)	−.17(168)*	−.08(149)

Note. The number of observations each correlation is based on appears in parentheses.
$^*p < .05$.
$^{**}p < .01$.

emphasis on teaching to have consulted more frequently external authorities, especially when raises were more heavily based on teaching effectiveness. Because attitude Likert items were reverse scored, lower factor scores signify greater agreement. Faculty at institutions placing greater emphasis on teaching effectiveness in decisions of tenure, promotion, and raises viewed teaching as more important than did faculty at institutions where teaching expectations were lower. There was a slight tendency for faculty with training in instruction to have been at institutions placing a greater emphasis on teaching when making a promotion.

Supplemental Analyses. One-way ANOVAs were used to compare faculty of different subject areas (biology, chemistry, earth science, physics, science methods, mathematics, and mathematics methods) on the sources of instructional innovation access factors scores and the faculty perception of teaching factor scores. In no case did an ANOVA produce a significant overall model. Consequently, there is no evidence that faculty of any subject area were more likely to access sources of instructional innovation more frequently than those in any other subject area or perceive their roles as instructors differently.

The columns of Table 7 provide the percentages of respondents who had available, had used, and would like to have or retain specific supports for instructional innovation at their institutions. Ideally, there should be a close match between these columns. In other words, faculty members who want the supports should have access to them and use them. Discrepancies between the columns were informative. For instance, most faculty members had access to and wished to maintain internal grants for technology and for travel, an office of instructional innovation, and paid sabbaticals, but rarely used them. On the other hand, internal grants for course development and an institutional educational newsletter were not generally available but were desired by most instructors.

Did junior faculty consult sources of instructional innovation more frequently and have more positive attitudes toward teaching than senior faculty? To address this question, faculty rank (Item 2) was converted to an ordinal variable. Instructors were assigned a 0, assistant professors were assigned 1, and so forth. Those who specified *other* (.5%) were excluded. Faculty rank was then correlated with the factor scores for accessing sources of instructional innovation and attitudes toward teaching. Those higher in academic rank tended to view teaching as less important ($r = .15$, $p < .05$) and were less likely to have training in pedagogy ($r = .27$, $p < .01$). No other correlations were significant.

Table 7

Percentages of respondents who had available, had used, and would to like to have or maintain specific supports for instructional innovation

	Currently Available	Consulted at Least Once in Last 5 Years	Wish to Have or Retain
Internal grants for technology	82.4	45.4	85.7
Summer employment	75.1	40.5	80.0
Internal grants for travel to educational workshops	66.7	23.7	78.1
Office for educational innovation	65.0	30.2	67.0
Overload compensation	61.9	26.6	69.7
Unpaid sabbaticals	60.7	0.0	0.0
Paid sabbaticals	59.6	7.9	76.2
Teaching assistants	44.1	33.9	65.3
Release time from teaching	38.4	25.0	73.9
Internal grants for course development/improvement	36.8	9.8	83.0
Institutional newsletter	37.5	21.9	55.8

Were faculty members who received formal training in effective teaching during graduate school more likely to access sources of instructional innovation information? To answer this question, scores on Item 38 were correlated with the access to sources of instructional innovation information factor scores. Those with graduate training in pedagogy were more likely to consult external authorities for instructional innovation information ($r = -.27$, $p < .01$) and were more likely to consult with others ($r = -.18$, $p < .01$).

Finally, each of the previous analyses (analyses relevant to Issues 1–4 and the supplemental analyses, except this one) were redone with the 12 faculty who taught methods classes removed (8 mathematics methods, 4 science methods) to see if the conclusions reached would change. None of the statistical results were appreciably different. For instance, no correlations that were previously insignificant became significant and vice versa. Moreover, no factor loadings changed by more than .01, and so forth. In retrospect, given the small percentage of the sample comprised of methods instructors and the lack of statistical power that this entails, it was unlikely that the results would be altered appreciably.

Discussion

A number of studies have concluded that learner-centered instruction is infrequently used in college science and mathematics classrooms (Kardash & Wallace, 2001; National Science Foundation, 1996; Seymour & Hewitt, 1997). Unlike most studies that survey students, Walczyk and Ramsey (2003) surveyed the science and mathematics faculty of Louisiana. Even though Louisiana had received STEM education funding since 1993, use of learner-centered instruction was nonetheless low. Related to this, Wright and Sunal (2004) identified nine institutional barriers that can undermine efforts to innovate in science and mathematics classrooms. With these and other barriers in mind, the present research sought to help rectify this situation by uncovering perceived obstacles to innovation according to the science and mathematics faculty of Louisiana. To this end, a survey was developed, the ISIIS, which was sent out over the Internet to all accessible faculty; 28.48% were eventually completed and returned. Four issues were raised and supplemental analyses conducted that provide insight on barriers to instructional innovation, as discussed next.

Issue 1: How Much Weight Is Perceived by Instructors to Be Assigned to Teaching Effectiveness by Institutions of Higher Learning When Making the Personnel Decisions of Tenure, Promotions, and Raises?

Results clearly reveal that teaching effectiveness is generally perceived to be assigned a low weight in important personnel decisions according to instructor perceptions. Perhaps the most surprising and alarming finding was the high percentage of faculty, between one quarter and one third, who were at institutions with no formal policy, with a formal policy of which they were ignorant, or had a policy of assigning no weight to teaching effectiveness in important personnel decisions. These data confirm the barrier of management identified by Wright and Sunal (2004) and others (e.g., Baiocco & DeWaters, 1998; National Research Council, 1999) that administrators often fail to communicate clear expectations to faculty concerning the importance of instruction or do not value instruction highly enough. If greater weights assigned to teaching effectiveness and expectations were more clearly communicated, it is possible that undergraduate science and mathematics instruction might eventually become more learner-centered.

Issue 2: How Frequently Are Nontraditional or Long-Term Measures Perceived to Be Used by Institutions of Higher Learning to Assess Teaching Effectiveness?

Just as nontraditional assessments of students are necessary to confirm attainment of learner-centered outcomes in students, they also are necessary to confirm the efforts and successes of college instructors in teaching in learner-centered ways (National Research Council, 1999). In other words, management must go beyond student ratings and open-ended comments when assessing teacher effectiveness (Bell & Denniston, 2002; Chickering & Gamson, 1999; Walczyk & Ramsey, 2003). According to the present data, traditional assessments still dominate in most science and mathematics classrooms. If nontraditional assessments occurred more often, faculty and students might innovate in the classroom and become more comfortable with such innovation, respectively. Such measures might include student interviews before graduation time, surveys of their professional attainments postgraduation, classroom observations, evidence of instructional innovation, and so on. If instructors were evaluated more heavily based on such criteria, their teaching might become more learner centered. With the big societal push presently occurring in American education for greater accountability and the fact that many standardized tests have been redesigned to include writing and critical-thinking components (Anastasi & Urbina, 1997), nontraditional and long-term measures of teaching effectiveness may be imposed from without (National Research Council, 1999; National Science Foundation, 1999). If the result of this were to move college science and mathematics instruction in learner-centered directions, then it would be of good effect. An important caveat, if the transition to learner-centered instruction is to occur smoothly and voluntarily, is that faculty members must be brought on board by management by helping the former to see its value and by providing them with the necessary supports and incentives to achieve this transformation (National Research Council, 1999; Wyckoff, 2001). Budgets also must expand, given the additional expense that such assessments entail (Wright & Sunal, 2004).

Issue 3: How Often Have Science and Mathematics Faculty Received Formal Training in Pedagogy?

Wright and Sunal (2004) noted that faculty must be willing participants if innovation in the classroom is to succeed. The present data confirmed a widely held belief that has not been sufficiently tested. They reveal that rarely do science and mathematics faculty have formal training in pedagogy. In the absence of such training, faculty are unlikely to use innovative approaches to instruction or understand the need for them (McGinnis, 2002; National Science Foundation, 1999; Uno, 1999; Wyckoff, 2001). When faculty members have received such training, they are more likely to teach in a learner-centered manner (Marsh & Hattie, 2002; Walczyk & Ramsey, 2003). Recall in the supplemental analyses described earlier that faculty who had formal training in pedagogy in graduate school were more likely to consult sources of instructional innovation information than those not formally trained.

Issue 4: When Institutions Are Perceived to Place Greater Weight on Teaching Effectiveness in Making Personnel Decisions, Are Faculty Members at Those Institutions More Likely to Be Committed to Instructional Innovation?

To our knowledge, the present study may be the first to provide data directly relevant to Issue 4 gathered from the science and mathematics faculty members themselves. Though correlational, analyses relevant to answering this question showed that faculty at institutions that assigned greater weight to teaching effectiveness in important personnel decisions were more likely to consult external authority for instructional innovation information, especially for raises. The present data also verified that faculty at these institutions were more likely to view teaching to be an important part of their professional identities. That the correlations of Table 6 were not larger in magnitude may be partially attributable to range restriction in the weights assigned to teaching effectiveness in personnel decisions. Weights were not distributed evenly across the possible ranges. Rather, distributions were positively skewed.

Supplemental Analyses

It is clear from Table 7 that faculty had access to many supports for instructional innovation and wished to retain them, but often infrequently used them. It will be difficult for management to justify retaining existing supports or adding new ones when those in place are not used. This infrequent use was likely due to many factors (National Research Council, 1999; Wright & Sunal, 2004). In the present study, there were seemingly minimal rewards in terms of tenure, promotions, or raises for such innovation from management. In fact, movement toward learner-centered instruction often produces a temporary drop in student ratings (Baiocco & DeWaters, 1998), thus having a negative effect on overall evaluation of faculty; however, note that when students perceive an increased workload in the classroom to be in their self-interest, ratings are less likely to go down as a result (Marsh, 2001; Wyckoff, 2001). Moreover, because of their general lack of training in pedagogy, faculty may not have perceived the need for nor understood the means by which to improve their instruction (McGinnis, 2002; Wyckoff, 2001). Consistent with this possibility, respondents who had formal training in pedagogy in graduate school (who also tended to be junior faculty) were more likely to have consulted external sources of instructional innovation and to have consulted others. There is a suggestion herein that administrators should provide faculty with pedagogical training and support their efforts to make instruction learner centered, especially by making the required budget allocations (Wright & Sunal, 2004). Consistent with the recommendation of the NRC (1999), formal training in learner-centered instruction should be made a formal part of doctoral programs of study in sciences and mathematics.

Implications for Promoting Instructional Innovation in Science and Mathematics Classrooms

No isolated or short-term intervention is likely to produce global, lasting improvements in the use of learner-centered instruction in colleges and universities. Rather, systemic reform of college science and mathematics instruction will be necessary (National Science Foundation, 1996, 1999; Wright & Sunal, 2004). With the caveat that future research must be conducted that points to causal connections between the interventions suggested next and the attainment of learner-centered instruction with broader samples, the following recommendations are made based on the present data.

Increase Incentives for Instructional Innovation. The present data showed that the perceived weights assigned to instruction in important personnel decisions were generally low and expanded on previous research by showing that in a large percentage of cases, weights were unknown to faculty. Moreover, analyses relevant to Issue 4 revealed that when schools assigned greater perceived weights to evidence of teaching effectiveness in important personnel decisions, instructors were more likely to consult sources of instructional innovation information and consider teaching an important part of their professional identities. Based on these findings, the weight assigned to instruction at colleges and universities must increase and be more clearly communicated to faculty if instruction is to become more innovative. Only when faculty members feel that it is in their professional self-interest are they likely to make classrooms more learner-centered (Baiocco & DeWaters, 1998; Harwood, 2003; National Research Council, 1999; National Science Foundation, 1996; Walczyk & Ramsey, 2003; Wright & Sunal, 2004; Wyckoff, 2001).

Broaden How Teaching Effectiveness Is Assessed. The assessments traditionally used for evaluating teaching effectiveness are of the expeditious kind: student ratings and open-ended comments (Lawson et al., 2002; Marsh, 2001; McGinnis, 2002; Uno, 1999). The present data confirmed the infrequent perceived use of nontraditional measures of teacher effectiveness among a sample of faculty, many of whom do not innovate in the classroom (Walczyk & Ramsey, 2003). Almost all faculty members surveyed in the present study reported the use of student ratings; 68.4% reported the use of open-ended students' comment. Assessing teaching effectiveness from a learner-centered perspective, on the other hand, often requires the use of student interviews, postgraduation-success surveys, classroom observations made by qualified observers, rates at which undergraduates pass relevant national examinations, and similar measures (McGinnis, 2002). These were seldom used in the present sample. Of course, compared to traditional measures, nontraditional and long-term measures are much more expensive and effortful to obtain and interpret. Notwithstanding, if teaching effectiveness were measured using these measures, we believe that faculty instruction would become more learner centered as long as instructors received the incentives and supports necessary to make the transition (McGinnis, 2002; National Research Council, 1999; Wright & Sunal, 2004).

Systematically Providing Faculty with Pedagogical Training. The mean of Item 38 (see Table 5) reveals that a minority of science and mathematics faculty of Louisiana received training in teaching as part of their graduate programs. On other hand, supplemental analyses revealed that when such training occurred, faculty members were more likely to have consulted sources of instructional innovation information. These data suggest that such training should be required. Other research has similarly documented that faculty generally lack this training (Cross, 2001; Marsh & Hattie, 2002; National Science Foundation, 1996; Wyckoff, 2001). If part of the formal graduate training that prospective science and mathematics faculty receive is in the use of learner-centered instruction, they may be more likely to perceive innovation in the classroom as an important part of their professional identities, partake of workshops and other instructional-improvement opportunities, and understand the importance of learner-centered instruction (Bell & Denniston, 2002; McGinnis, 2002; Wyckoff, 2001). Moreover, instructional innovation is not a one-time occurrence but must be continuous. Readers interested in a description of a convenient, nonthreatening, and ongoing means of dispensing instructional innovation information to college faculty are referred to the last chapter of Baiocco and DeWaters (1998), who describe learning communities on the Internet.

Expanding Faculty Notions of Scholarship. Given the low or uncertain weights assigned to teaching observed herein, many colleges and universities of Louisiana downplay teaching and play up research. Unfortunately, despite a commonly held myth, there is little evidence that maintaining an active *basic research* program improves the quality of instruction faculty provide for students (Marsh & Hattie, 2002). Even so, based on in-depth analyses at three institutions of higher learning, Kezar and Eckel (2002) argued that if change at colleges and universities is to proceed and endure, such as the broad implementation of learner-centered instruction, the institution's culture must be taken into account by change agents. The authors noted that ''there is evidence that working within the culture facilitates change. If change strategies violate the institution's cultural norms and standards, they might be viewed as inappropriate and stifle the change process'' (p. 457). A change strategy that might facilitate adoption of learner-centered instruction at institutions whose culture underscores research is to encourage science and mathematics faculty to consider instructional innovation as another research outlet and reward it accordingly. Noting the trade-off that has long existed in the minds of faculty between investing in teaching and research productivity, Harwood (2003) recommended that science faculty conceptualize innovation in the classroom as another avenue for scholarship. There are many high-quality, peer-reviewed journals that publish the results of instructional innovation experimentation. For instance, the *Journal of Chemical Education* has published a study concerning the use of demonstration assessments in chemistry class (Deese, Ramsey, Walczyk, & Eddy, 2000). The *Journal of College Science Teaching* has published an investigation of the effects of cooperative learning on the achievement of biology students (Klionsky, 2002). Research on developing a new instrument for assessing the understanding of biology students also has been published in the *Journal of Research in Science Teaching* (Anderson, Fisher, & Norman, 2003). These journals are but a few of many. In addition and as noted by one of the reviewers, many professional organizations to which science and mathematics faculty members belong hold conferences sponsoring symposia, papers, and posters on instructional innovation. In other words, classroom experimentation is a research opportunity that many instructors rarely use (Harwood, 2003; Marsh & Hattie, 2002). Of course, educational research must be rewarded by management (Wright & Sunal, 2004).

Finally, the present research uncovered an interesting, novel finding. CFA revealed three latent variables concerning sources from which faculty obtained information for improving instruction: consultation with external authority, consultation with others, and consultation with internal authority. These variable groupings may correspond to learning preferences of individual faculty. Some faculty may be most comfortable learning about instructional innovation from peer-reviewed sources (external authority). Others may prefer learning through their own trial and error and from trusted colleagues (from others), and so forth. If future research replicates these categories, then institutional centers for instructional innovation would do well to heed them by matching sources of instructional information to faculty preferences.

Limitations of the Present Findings and Recommendations for Future Research

Several limitations of the present research must be noted or noted again when interpreting and generalizing its findings, each suggesting areas for future research. First, findings are based on self-report, correlational data. Consequently, assigning causal connections to the associations uncovered is risky. Another caveat is the fact that the data were based on faculty perceptions—for instance, the weights assigned to teaching in important personnel decisions—which may have been in error. Researchers might wish to corroborate these perceptions with those of administrators or with institutional records. Moreover, the calibration of the ISIIS should in some cases have allowed for more refined arrays of answer options. For example, instead of Items 27, 28, and 29 restricting responses to 1 to 25%, and so forth, responses such as 10, 20%, and so on would have allowed for more precise data collection. A modified ISIIS also might include items that measure the extent to which innovation in the classroom is rewarded when making important personnel decisions. Moreover, as noted by one of the reviewers, some schools allow faculty to specify how much weight will be assigned to instruction in making important personnel decisions, a possibility not taken into account by the ISIIS. If the ISIIS were modified along these lines, it could then be administered to a more nationally representative sample for the purposes of replication and extension of the present findings.

Notes

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Appendix A

Incentives and Supports for Instructional Innovation Survey

Please take a few moments to fill out this electronic survey that probes the extent to which faculty who teach undergraduate science, science methods, mathematics, and mathematics methods courses at institutions of higher learning of Louisiana are encouraged to improve their instruction. The results will help guide the state in determining funding priorities in its effort to improve undergraduate education. Data received will be kept strictly confidential and will not be communicated to administrators. Only summary statistics will be made public. This research was funded by the National Science Foundation.

If you wish, a letter thanking you for your participation in this research project will be sent to administrators of the university you designate. To arrange for a letter to be sent, send a separate email to . . . Be sure to include the names(s) and addresses of the individual(s) to whom you wish a letter to be sent. If you wish, the results of the survey will be made available to you at the conclusion of the research.

1. I am on the faculty of:

☐ Centenary College [5]
☐ Dillards University [1]
☐ Nicholls State University [13]
☐ Northwestern State University [11]

☐ Grambling State University [1]
☐ Louisiana College [2]
☐ Louisiana State University, Baton Rouge [42]
☐ Louisiana State University, Alexandria [4]
☐ Louisiana State University, Eunice [3]
☐ Louisiana State University, Shreveport [6]
☐ Louisiana Tech University [17]
☐ Loyola [10]
☐ McNeese State University [18]
☐ Southeastern Louisiana University [32]
☐ Southern University, Baton Rouge [0]
☐ Southern University, New Orleans [1]
☐ Southern University, Shreveport [2]
☐ Tulane [17]
☐ University of Louisiana-Lafayette [6]
☐ University of Louisiana-Monroe [16]
☐ University of New Orleans [18]
☐ Xavier University [10]

2. **Rank: I am a/an:** ☐ Instructor ☐ Assistant Professor ☐ Associate Professor ☐ Full Professor ☐ Other

3. **Gender:** ☐ Male ☐ Female

4. **Race:**
☐ African American ☐ Asian ☐ Caucasian (Non-Hispanic) ☐ Hispanic ☐ Other

5. **I have been teaching at the college level:**
☐ 0–4 years ☐ 5–10 years ☐ 11–20 years ☐ 20+ years

6. **How many courses do you typically teacher per semester/quarter?**
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 or more

8. **I teach undergraduate courses primarily in the area of (check all that apply):**
☐ Biology ☐ Chemistry ☐ Earth Science ☐ Mathematics
☐ Physics ☐ Other ☐ Math Methods ☐ Science Methods

9. **Do you have tenure?**
☐ Yes ☐ No ☐ I am not in a tenure-track position.

Sources of Ideas for Instructional Innovation
The following items concern sources that you may consult for instructional innovation. If you are unable to answer any of the following questions or any of the others of this survey, please estimate as accurately as you can from memory.

From Students
10. Approximately how many times during the last calendar year have you used **formal input** (e.g., ratings, open-ended comments) from your students to improve your effectiveness as an instructor?

[The scale used for question 10 also pertained to question 11 & 13.]
none 1 2 3 4 5 6 7 8 or more

11. Approximately how many times during the last calendar year have you **solicited informal input** (e.g., interviews) from your students concerning your effectiveness as an instructor?

From Colleagues
12. Approximately how many times during the last calendar year have you acquired ideas concerning ways to improve your instruction through discussion with colleagues?

[*The scale used for question* 12 *also pertained to questions* 15, 16, 17, & 19.]*
none 1 to 5 6 to 10 11 to 15 16 to 20 21 to 25 26 or more

13. During the last calendar year, approximately how many times have you obtained ideas concerning ways to improve your instruction by observing a colleague as she or he taught?

From Publications
14. How many periodicals do you subscribe to currently that provide information on effective teaching methods?
none 1 2 3 4 5 6 7 8 9 or more

15. How many books do you own currently that provide information on effective teaching methods?

16. Approximately how many times during the last calendar year have you consulted publications (e.g., books, journal articles, magazine articles) specifically for the purpose of improving your instruction?

From Educational Seminars/Workshops
17. How many times during the last 5 calendar years have you participated in workshops for the purpose of improving teaching that were **held at your institution?**

18. If your response to question 17 was other than none, please indicate all of the entities that (co)sponsored the workshops to the best of your recollection.

[*The options used for question* 18 *also pertain to question* 19.]
department college institution state agency federal agency professional organization
private foundation other (specify) _____ _____ _____ _____ _____ _____ _____ _____

19. Approximately how many times during the past 5 calendar years have you attended workshops **held outside your institutions** (e.g., other institutions of higher learning, national conferences, and so forth) for the purpose of improving your teaching?

20. If your answer to question 19 was other than none, please indicate all those entities that (co)sponsored the workshops to the best of your recollection.

From Other Sources
21. During the last calendar year, approximately how many times have you acquired information useful for improving your instruction from the Internet?

[*The scale used for question* 21 also pertained to questions 22 *through* 25.]
none 1 2 3 4 5 6 7 8 or more

22. During the last calendar year, approximately how many times have you acquired information useful for improving your instruction from the **television**?

23. Approximately how many times, during the last calendar year, have you obtained ideas useful for improving your instruction through your own classroom **experimentation** (**trial and error**)?

24. During the last calendar year, approximately how many times have you acquired information useful for improving your instruction from **professional organizations** to which you belong?

25. During the last calendar year, how many times have you acquired information useful for improving your instruction from your **institutional faculty development center**?

26. In the space provided, please indicate sources other than those mentioned above, if any, from which you have obtained ideas useful for improving your instruction during the past calendar year.

Incentives for Instructional Innovation

The items that follow concern inducements of your institution for instructional innovation.

27. Approximately what weight is given to a candidate's teaching effectiveness when decisions regarding tenure are made at your institution?

[*Questions* 27 *through* 29 *used the following* 6 *options.*]

none   1 to 25%   26 to 50%   51 to 75%   76 to 100%   no standard policy   do not know

28. Approximately what weight is given to a candidate's teaching effectiveness when decisions regarding **promotion** are made at your institution?

29. Approximately what weight was given to a candidate's teaching effectiveness when decision regarding the size of faculty **raises** in your department the last time they were given?

30. Indicate which of the following **are routinely reviewed to measure faculty teaching effectiveness** in your department.

    student ratings
    open-ended student comments
    course syllabi
    classroom observations
    attendance at educational workshops
    student interviews
    student portfolios
    evidence of student success following graduation
    (e.g., acceptance to graduate school, success in finding employment related to major)
    evidence of instructional innovation
    teaching awards received
    other (specify)_____ _____ _____ _____ _____ _____ _____ _____ _____

31. Indicate which of the following supports are **currently available to assist faculty at your institution in their attempts to improve their teaching effectiveness.**

[*The options of question* 31 *also pertained to questions* 32 *and* 33.]

    teaching assistants
    release time from teaching
    paid sabbaticals
    unpaid sabbaticals

overload compensation
summer employment
internal grants that support travel to educational workshops
internal grants that support the purchase of instructional materials or technology
internal grants that compensate faculty for time spent in course or program improvement
institutional office that supports educational innovation
institutional newsletter that supports educational innovation
other (specify) _____ _____ _____ _____ _____ _____ _____ _____ _____

32. Indicate which of the following institutional supports that **you have used or consulted at least once** in the last 5 calendar years in your attempts, if any, to improve your teaching effectiveness.

33. Indicate which of the following institutional supports **you would like to have in place or would like to retain at your institution.**

Indicate how strongly you agree or disagree with each statement below.
[*Questions* 34 *through* 43 *pertain to the Likert scale below.*]

Strongly Agree Strongly Disagree
1 2 3 4 5

34. Providing excellent instruction is a strong expectation at my institution.
35. My job is simply to present information to the students.
36. Providing excellent instruction is a major component of my duties as a faculty member.
37. Providing excellent instruction is crucial to my success in this department.
38. I received formal training in effective teaching methods while in graduate school.
39. Research productivity is more important than instructional innovation in my professional success.
40. It is my responsibility to create a classroom environment that requires students to think critically.
41. I have received support from faculty mentors in my attempts to improve my teaching.
42. It is important to experiment with (try out) new instructional techniques in the classroom.

* Note: Bracketed, italicized text were not part of the survey.

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