Faculty Technical Currency: Status Report on a National Survey of Engineering Technology Faculty

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Abstract

Rapid technological growth has put new demands on engineering and engineering technology educators. Industry seeks graduates with up-to-date technical knowledge. The half-life of an engineer's technical skills - how long it takes for half of everything an engineer knows about the field to become obsolete - is becoming strikingly short. The pace of technological change has also imposed new challenges on faculty development and technical currency programs. Faculty professional development activities and technical currency play an important role in promoting student learning and success.

Especially for non-research (purely teaching) institutions that offer technology driven programs, one of the most important factors determining student success is the technical currency of faculty members. The Accreditation Board for Engineering and Technology (ABET) and regional accreditation bodies place strong emphasis on the technical currency of faculty, and require institutions to provide opportunities for faculty to keep abreast of technological advances. ABET's new criteria for accrediting engineering technology programs, Technology Criteria 2000 (TC2k), also emphasize the importance of faculty technical currency.

Thus, the rapid pace of technological change coupled with the shortened "half-life" of engineers, mandate that faculty remain current in their areas of specialization in order to help students acquire an up-to-date technological knowledge base.

This paper presents the findings of a faculty survey conducted through the ASEE ETD listserv which presently has a membership of more than 3000 faculty members and professionals belonging to more than 677 institutions. The intent of the survey was to

gauge the status of professional development activities vis-à-vis faculty technical currency at personal, departmental and institutional levels in the domains of engineering technology. The survey also explored faculty input regarding the importance of technical currency and its relationship to student learning and success. Statistical analyses were performed on the collected data to determine predictor variables for faculty technical currency. The statistical analyses revealed that the "institutional support and encouragement for maintaining technical currency," and "allocation of funds for professional development" are the most significant predictors for maintaining faculty technical currency. In light of survey findings, recommendations are made to improve faculty development activities and departmental policies to enable faculty to stay current in their fields of specialization. As technology leapfrogs and new technological domains evolve, it becomes increasingly important to synchronize the curriculum development and revision cycle with the planning and implementation of faculty development activities.

I. Introduction

The exponential rate of technological advances is forcing a paradigm shift in education. Teaching in today's world requires new approaches to instruction. The profound and pervasive changes occurring in education are placing new demands on educators. Educators are expected to be technically current and to learn the mechanics of teaching/learning in order to become effective teachers. These new challenges are transforming teachers into life-long learners.

The half-life of an engineer's technical skills - how long it takes for half of everything an engineer knows about his or her field to become obsolete - is becoming strikingly short. According to the National University Continuing Education Association, for mechanical engineers it is 7.5 years; electrical engineers, 5 years; software engineers, a mere 2.5 years [1]. These estimates were devised almost a decade ago; considering the rapid pace of technological growth, these numbers are surely even smaller today.

Accreditation bodies such as Accreditation Board for Engineering and Technology (ABET) place high emphasis on the technical currency of faculty, and require institutions to provide opportunities for faculty to keep abreast of the pace of technological advances. ABET's 2003-2004 criteria for accrediting engineering technology programs state [2]:

> In engineering technology programs, technical currency is important and must be assured by such means as a competent and inquisitive faculty, an active industrial advisory committee, and an adequately funded budget which encourages continuing faculty development, and a modern library collection with an adequately funded program for continuous renewal. Positive procedures must be established and closely monitored to safeguard against technical obsolescence. (ABET, 2003, p.5)

ABET's criteria for accrediting engineering technology programs, known Technology Criteria 2000 (TC2k), also emphasize the importance of faculty technical currency:

> The overall competence and effectiveness of the faculty are manifested by such factors as formal education, industrial experience, professional certification, teaching experience, teaching effectiveness, technical currency, scholarly activity, professional society participation, communication skills, extracurricular support for student activities, and similar attributes appropriate to the goals of the program. (ABET, 2003, p.34)

The relationship between teaching and learning is a complex process. How students learn and how teachers teach are complicated processes, difficult to understand and even harder to master. Effective teaching is one of the means of ensuring maximum student learning. What is effective teaching? Hativa makes the following observation [3]:

> Effective teaching is defined as teaching that brings about effective and meaningful student learning. Successful student learning is achieved through a continuous process of students' linking new knowledge to their experiences and their existing knowledge base. This process fosters the expansion of new knowledge and its integration with learners' prior knowledge and understanding, so that it can be used most effectively in new tasks and transferred more readily to new situations (2000, p.23).

Professor Guskey of University of Kentucky, in his book *Improving Student Learning in College Classrooms*, identifies the shortcomings of new and experienced college professors. For new professors, he identifies a key shortcoming: their lack of pedagogical skills or lack of formal training in pedagogy. He observes [4]:

> New professors generally come to their positions through an informal apprentice system, are immediately given enormous teaching responsibilities, and yet have had little or no opportunity to study teaching in an organized systematic way. Left on their own to develop pedagogical skills, they typically fall back upon recollections of former teachers from their own student days and attempt to model the classroom practices they recall as best. (1988, p.5)

And regarding the experienced college teachers, professor Guskey points out their key weakness:

> Research shows that after the first couple of years in the college classroom, most professors and instructors settle into a fairly stable pattern of instructional practices. Based almost on trial-and-error learning, they develop a personal repertoire of instructional techniques that is only occasionally refined as a result of classroom experiences. Although typically derived without the benefit of critical reflection or collegial feedback and exchange, this repertoire provides these veterans of college classrooms with a sense of security and certainty about what to do, how to do it, what will work, and what is likely not to work. Suggestions of major revision to their instructional practices threaten that hard-earned security and certainty. Not only would such revision require additional time and effort in an already burdensome schedule, it also carries the risk of

diminished effectiveness and possible failure. For these reasons experienced college teachers are usually reluctant to make major changes in the way they teach…" (p.6)

Professor Guskey argues that knowledge we have gained from modern studies of college teaching has identified various aspects of the teaching and learning process that can be altered with relative ease and yet can be very powerful in helping students build successful learning experiences. And regarding the transformation of professors into effective of college professors, Professor Guskey observes that "enhancing one's effectiveness as a college teacher clearly requires a certain amount of time, effort and commitment. It also requires some experimentation, and a tolerance for the occasional failures and setbacks that are likely to occur." (p.27)

During the past decade the phenomenal growth of personal computer (PC) industry has led to emergence of a new form of economy called the "Internet economy," which is rapidly becoming an integral part of the overall U.S. economy. The magnitude of the growth Internet economy is evident by the following indicators released by the Center for electronics commerce, graduate school of business, University of Texas at Austin [5]:

- The Internet economy now directly supports more than 3 million workers.
- Employment in the Internet Economy companies is growing much faster than in the overall economy.
- The Internet economy generated an estimated $830 billion in revenues in 2000, a 58 percent increase over 1999. The $830 billion in revenues is a 156 percent increase from 1998, when the Internet accounted for $323 billion in revenues.

Table 1 compares the growth of U.S. economy with the emergence of the Internet economy for 1995 and 1999 [6].

Table 1. Emergence of New Internet Economy

	1995	1999	Cumulative Annual Growth Rates (CAGR)
United States -Gross Domestic Product (GDP)	$ 6,762 b	$ 7,801 b	3.5%
New Internet Economy	$ 5 b	$ 507 b	213%

Source: Center for Electronics Commerce, Graduate School f Business, University of Texas at Austin

The swift pace of technological change is transforming the global economy into a knowledge-based economy, in which organizations are no longer valued on the basis on

their physical assets but rather on the knowledge-base of their employees. And in this new knowledge-based economy the wealth of a nation is determined by its intellectual capital.

The emergence of the Internet economy (knowledge-based economy/digital economy) due to the growth of PC/networking technologies, has also led to an increase in the enrollment numbers of the distance education programs in public and private institutions. The scale of this increase can be gauged by the following facts and figures published by the national center for education statistics in its report titled "*Distance Education at Degree Granting Postsecondary Institutions: 2000-2001*" [7]:

> Fifty-six percent (2,320) of all 2-year and 4-year degree granting institutions offered distance education course for any level or audience…Ninety percent of public 2-year and 89 percent of public 4-year institutions offered distance education courses, compared with 16 percent of private 2-year and 40 percent of private 4-year institutions…(Distance education was defined for this study as education or training courses delivered to remote [off-campus] sites via audio, video [live or prerecorded], or computer technologies, including both synchronous [i.e., simultaneous] and asynchronous [i.e., not simultaneous] instruction) (p. iii).
>
> There were an estimated 3,077,000 enrollments in all distance education courses offered by all 2-year and 4-year institutions…Public 2-year institutions had the greatest number of enrollments in distance education course, with 1,472,000 out of 3,077,000 or 48 percent of the total enrollments in distance education. Public 4-year institutions had 945,000 enrollments (31 percent), and private 4-year institutions had 589,000 enrollments (10 percent of the total) (p. iv)
>
> The Internet and two video technologies were most used as primary modes of instructional delivery for distance education courses (p. v)

With this mushroom growth of the distance education programs in private and public institutions, the faculty technical currency thus becomes a pivotal factor for the design, implementation and delivery of effective online programs that can promote student learning/success.

In his book *The Digital Economy: Promise and Peril in the Age of Networked Intelligence,* Tapscott proposes a dozen themes for this new economy. The first is knowledge. On the requirements of digital economy and faculty practices, he makes the following observations [8]:

> The digital economy requires a far-reaching rethinking of education and, more broadly, learning and relationship (among) working, learning, and daily life as consumer. (p.197)

> With tenured professors, teachers threatened by technology, less competition, and teaching traditions dating back centuries, many educational institutions have become mired in the past. (p.201)

In 1996, the National Commission on Teaching and America's Future issued their report titled *What Matters Most: Teaching for America's Future*. The commission drew the conclusion that effective school reform would depend primarily on investments aimed at providing teachers with increased access to the knowledge they need to meet the demands of the profession.

The concept of faculty development deals with helping faculty members improve their competence as teachers and scholars [9]. Furthermore, improving faculty competence is a part of improving overall instructional quality. The efforts to increase instructional quality depend on faculty development (focus on faculty), instructional development (focus on student, course and curriculum), and organizational development (focus on structure and process) [10].

Faculty in purely teaching institutions (non-research environment) especially those teaching in technology-based and career-oriented programs, generally lag behind the pace of technological change in terms of their professional development activities due to their non-association with research activities. They face two major challenges: how to incorporate and teach new applications of new technologies in the curriculums they teach and how to maintain their professional currency.

Therefore, in summary, the rapid pace of technological change mandates that faculty remain current in their technical areas of specialization as technology leapfrogs and new domains of technology evolve, and thus they need to become reflective practitioners.

For this article, it was the intent of authors to survey faculty teaching in engineering technology domain to determine the state of professional development and processes that are used to maintain technical currency.

II. Data Collection Procedure

To gauge the status of professional development activities vis-à-vis faculty technical currency at personal, departmental and institutional level in the domains of engineering technology, the faculty survey was conducted through the ASEE ETD listserv which presently has a membership of more than 3000 faculty members and professionals belonging to more than 677 institutions. The participants were asked to submit their responses anonymously. They were also given the option of submitting the survey via web, e-mail, fax or snail mail. Appendix A exhibits the survey instrument used for data collection.

III. Findings

Table 2 summarizes the frequency and percentage of responses indicating faculty perceptions about the various aspects of technical currency, its relationship to student learning/success, and the impact of TAC of ABET's TC2k accreditation criteria on the revision of institutional policies to promote faculty development activities and on allocation of financial resources for faculty developmental activities.

Table 2. Results for Survey Questions 1-10 (Technical Currency Issues)

N= 226	SD	D	MD	N	MA	A	SA
F = Frequency %=Percentage (% ∃10 is underlined)	F (%)	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)
1. Because of the application orientation of engineering technology programs, technical currency of faculty is essential to make student learning more relevant.	1(0.4)	3(1.3)	1(0.4)	0(0)	6(2.7)	78(34.5)	137(60.6)
2. I believe that there is a strong relationship between the technical currency of the faculty member and student learning/success.	3(1.3)	5(2.2)	10(4.4)	9(4.0)	34(15.0)	89(39.4)	76(33.6)
3. My institution supports and encourages faculty members to maintain technical currency.	6(2.7)	17(7.5)	14(6.2)	20(8.8)	63(27.9)	76(33.6)	30(13.3)
4. My chairperson supports and helps me plan professional development activities to maintain technical currency.	14(6.2)	21(9.3)	18(8.0)	38(16.8)	40(17.7)	63(27.9)	32(14.2)
5. I believe that I have maintained technical currency during the past 5 years, enabling me to teach courses effectively.	4(1.8)	8(3.5)	8(3.5)	8(3.5)	53(23.5)	81(35.8)	64(28.3)
6. My institution has allocated sufficient funds for the professional development activities of faculty during the past 5 years.	43(19.0)	25(11.1)	29(12.8)	30(13.3)	52(23.0)	34(15.0)	13(5.8)
7. There is an urgent need in my department/program to improve existing policies in order to allow faculty to enhance their technical currency.	7(3.1)	34(15.0)	16(7.1)	37(16.4)	47(20.8)	45(19.9)	40(17.7)

8. There is an urgent need in my department/program to increase funding for faculty development activities.	3(1.3)	22(9.7)	17(7.5)	29(12.8)	38(16.8)	60(26.5)	57(25.2)
9. ABET's new TC2K accreditation criteria will encourage my institution to revise policies in order to promote faculty development activities in order to keep faculty technically current.	21(9.3)	22(9.7)	14(6.2)	77(34.1)	41(18.1)	46(20.4)	5(2.2)
10. ABET's new TC2K accreditation criteria will encourage my institution to allocate adequate financial resources for faculty development activities.	23(10.2)	23(10.2)	23(10.2)	84(37.2)	39(17.3)	28(12.4)	6(2.7)

1. Technical currency of faculty is essential to make student learning more relevant: Out of 226 respondents, 60.6% said they agree (A) while 34.5% said that they strongly agree (SA) with notion that because of the application orientation of engineering technology programs, technical currency of faculty is essential to make student learning more relevant, whereas 1.3% disagreed (D), and 0.3% strongly disagreed (SD).

2. Strong relationship between technical currency and student learning: 33.6% of respondents strongly agree (SA), 39.4% agree (A), 15% moderately agree (MA), 1.3% strongly disagree (SD) and 2.2% disagree (D) with the concept that there is a strong relationship between the technical currency of the faculty member and student learning/success.

3. Institutional support/encouragement for faculty to maintain technical currency: 13.3% respondents strongly agree (SA), 33.6% agree (A), 27.9% moderately agree that they have institutional support/encouragement to maintain technical currency, while 2.7% strongly disagree (SD), 7.5% disagree (D), 6.2 moderately disagree (MD) and 8.8% expressed no opinion (N).

4. Chairperson's support for faculty for professional development activities/maintenance of technical currency: 14.2% of respondents strongly agree (SA), 27.9% agree (A), 17.7% moderately agree (MA), 6.2% strongly disagree (SD), 9.3% disagree (D), and 8% moderately disagree (MD) that their chairperson helps and supports them to plan their professional development activities to maintain technical currency, and 16.8% expressed no opinion (N).

5. Faculty maintained technical currency during past 5 years to teach effectively: 28.3% participants strongly agree (SA), 35.8% agree (A), 23.5% moderately agree with the idea that they have maintained technical currency during the past 5 years to teach

courses effectively, while 1.8% strongly disagree (SD), 3.5% disagree (D), 3.5% moderately disagree (MD) and 3.5% expressed no opinion (N).

6. Institution has allocated sufficient funds for professional development during the past 5 years: Only 5.8% of respondents strongly agree (SA), 15% agree (A), 23% moderately agree with the statement that the institution has allocated sufficient funds for the professional development activities of faculty during the past 5 years, while 5.8% strongly disagree (SD), 15% disagree (D), and 23% moderately disagree, and 13.3% expressed no opinion (N).

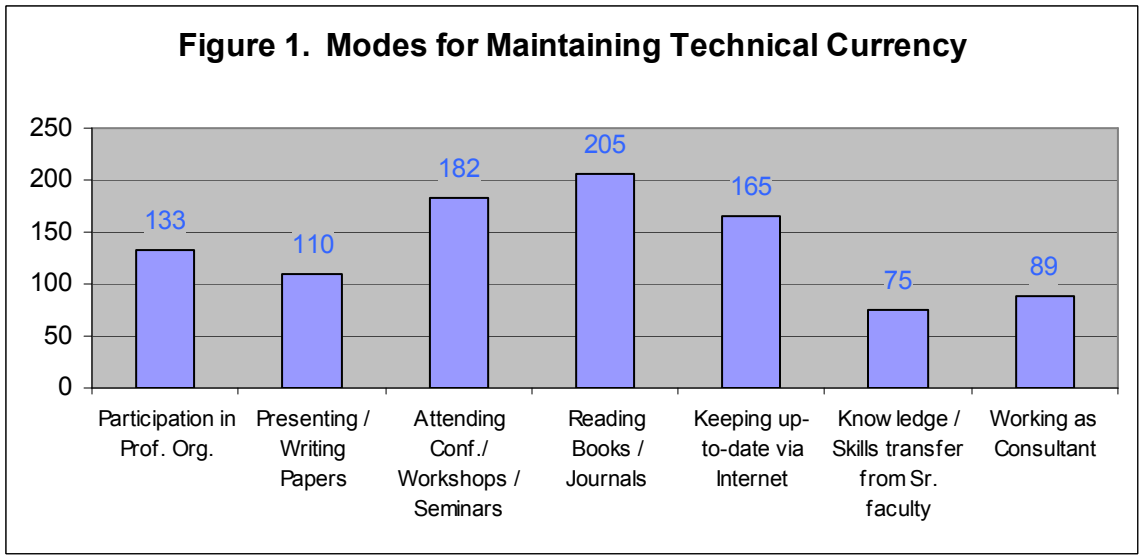
7. Urgent need to improve existing departmental polices to allow faculty enhance their technical currency: 17.7% of the faculty members strongly agree (SA), 19.9% agree (A), 20.8% moderately agree (MA) with the suggestion that there is an urgent need at department/program level to improve existing policies in order to allow faculty members enhance their technical currency, while 3.1% strongly disagree (SD), 15% disagree (D), 7.1% moderately disagree (MD) and 16.4% expressed no opinion (N).

8. Urgent need to increase department/program funding for faculty development activities: 25.2% of respondents strongly agree (SA), 26.5% agree (A), 16.8% moderately agree with the statement that there is an urgent need to increase funding at department/program level for faculty development activities, while 1.3% strongly disagree (SD), 9.7% disagree (D), and 7.5% moderately disagree (MD, and 12.8% expressed no opinion (N).

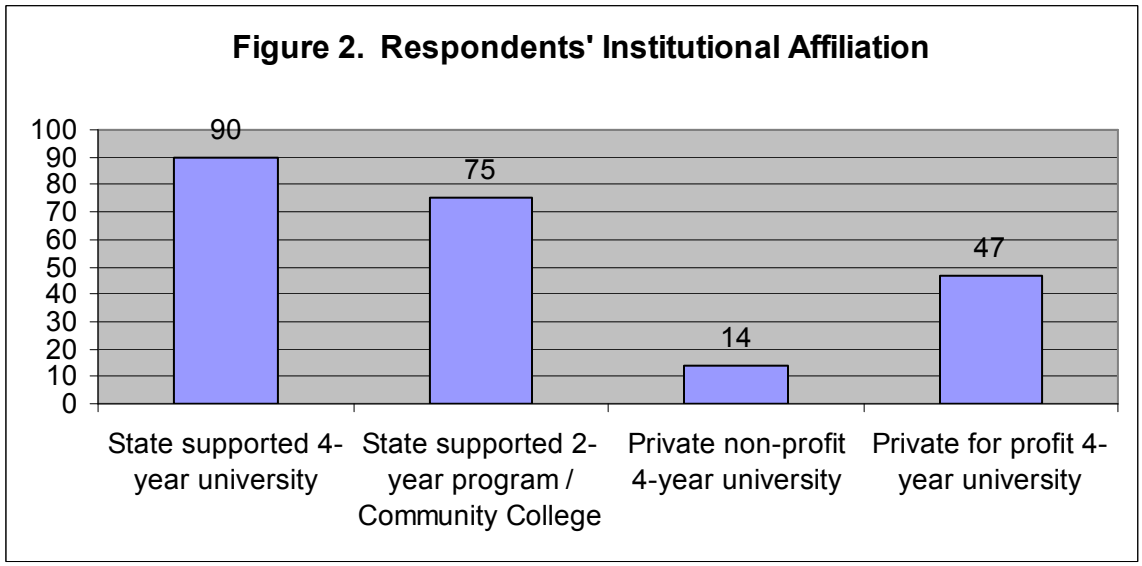
9. Impact of ABET's TC2K accreditation criteria on revision of institutional policies for promoting faculty developmental activities to keep faculty technically current: Only 2.2% of respondents strongly agree (SA), 20.4% agree (A), 18.1% moderately agree (MA) with the idea that ABET's TC2K accreditation criteria will encourage their institutions to revise policies for promoting faculty development activities in order to keep faculty technically current, while 9.3% strongly disagree (SD), 9.7% disagree (D), and 6.2% moderately disagree (MD), and 34.1% expressed no opinion (N).

10. Impact of ABET's TC2K accreditation criteria on allocation of adequate financial resources for faculty development activities: Only 2.7% participants strongly agree (SA), 12.4% agree (A), 17.3% moderately agree (MA) with the notion that ABET's TC2K accreditation criteria will encourage their institutions to allocate adequate financial resources for faculty development activities, while 10.2% strongly disagree (SD), 10.2% disagree (D), 10.2% moderately disagree (MD), and 37.2% expressed no opinion (N).

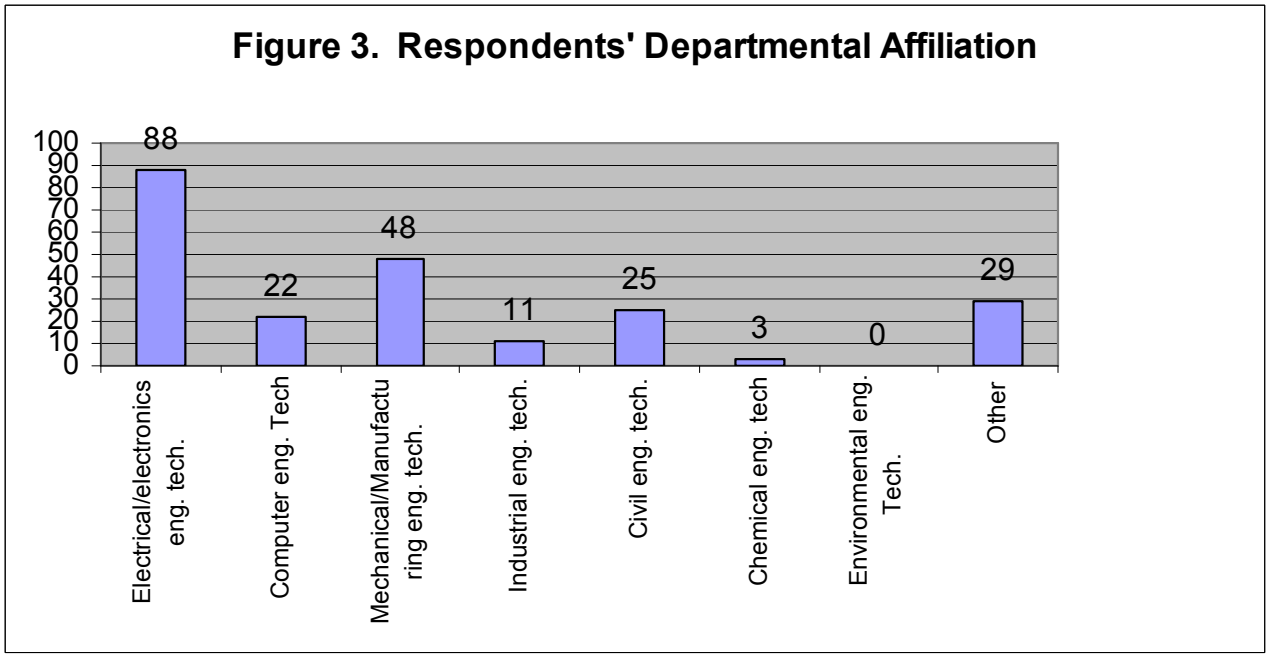
11. Modes for maintaining technical currency: Figure 1 shows the frequency distribution of various modes used by respondents to maintain their technical currency. Reading books, magazines and journals; attending conferences/technical workshops/seminars; and keeping up-to-date via the Internet are the most widely used modes for faculty to maintain their technical currency, whereas working as consultants and knowledge/skills transfer from senior faculty/colleges are the least practiced modes.



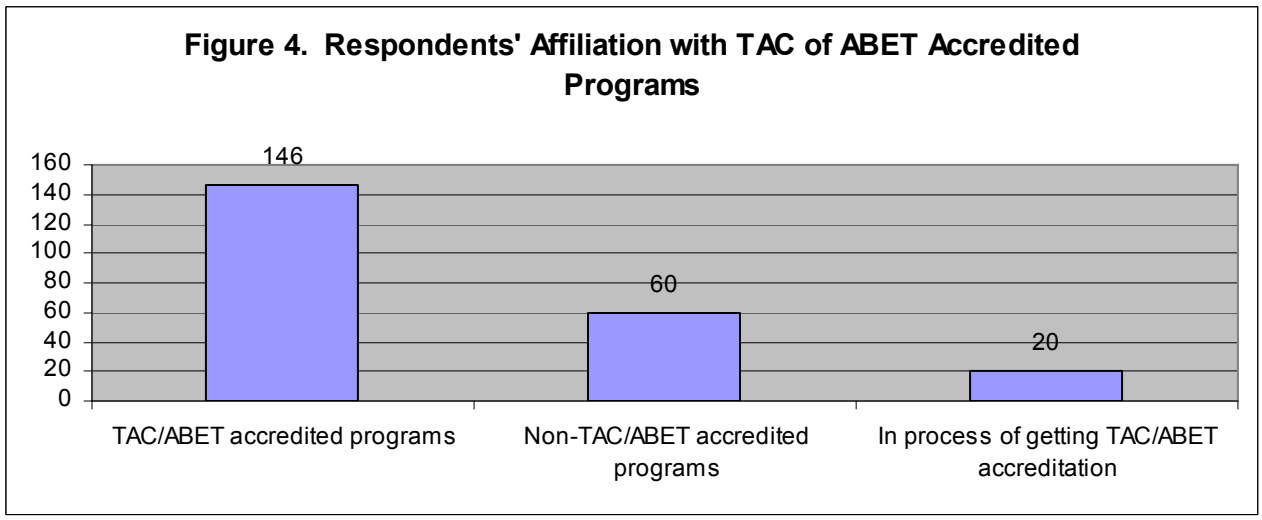
12. Institutional Affiliation: Figure 2 shows the frequency distribution of respondents' institutional affiliations.



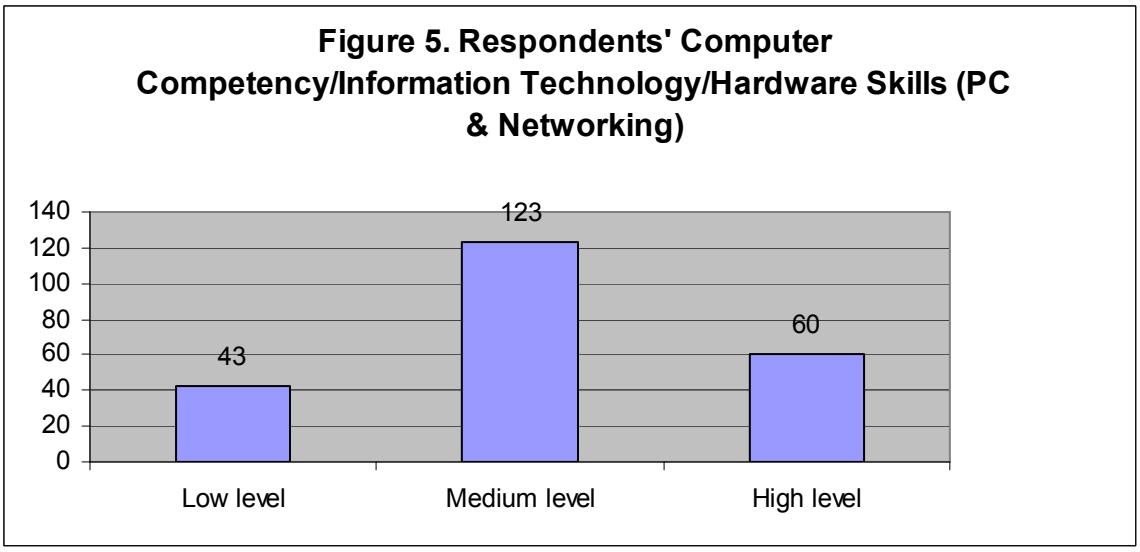
13. Departmental Affiliation: Figure 3 shows the frequency distribution of respondents' professional areas.



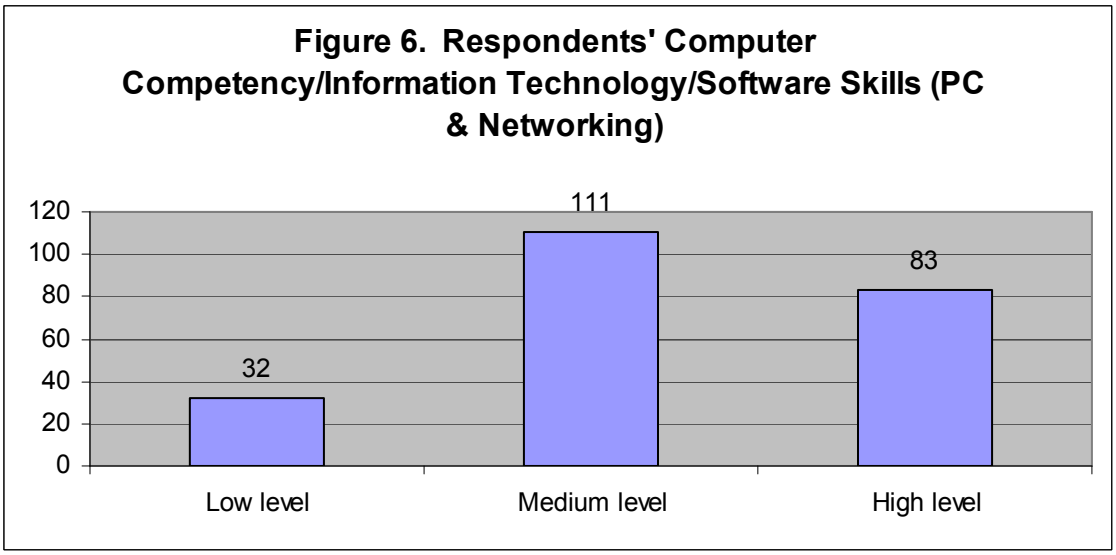
14. Respondents' Affiliation with TAC of ABET Accredited Programs: Figure 4 shows the frequency distribution of respondents' affiliations with TAC of ABET accredited programs.



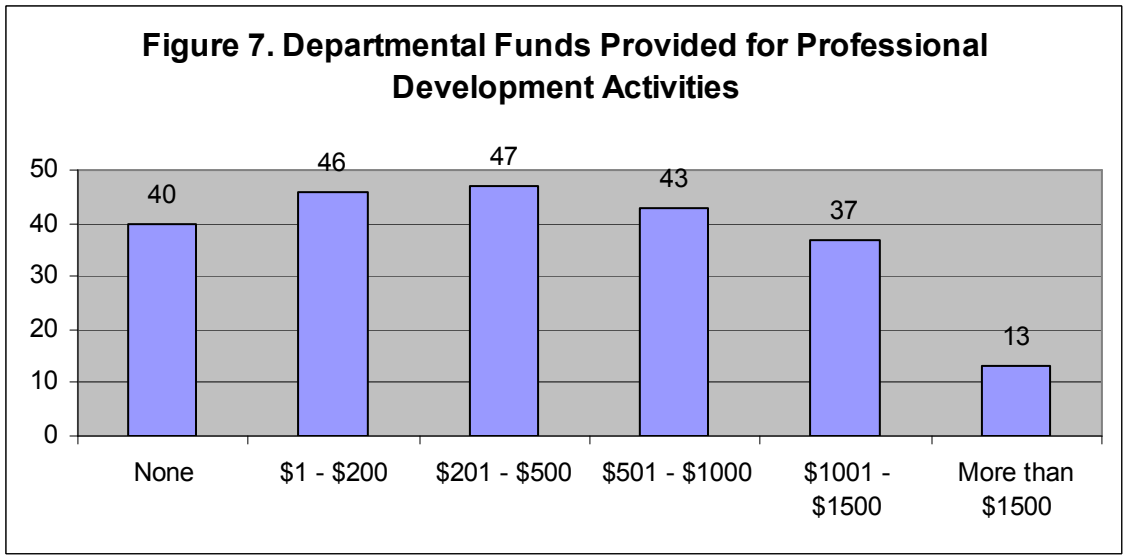
15. Respondents' Computer Competency/Information Technology (IT) hardware skills (PC & Networking): Figure 5 illustrates the respondents' computer/IT/networking hardware skills. Nineteen percent reported low-level skills i.e. they have basic understanding of computer hardware/network systems; 54.4% of respondents said that they have medium-level skills, i.e., they have understanding of computer/network systems; and 26.5% reported to have high-level skills, i.e., they can design hardware/network systems.



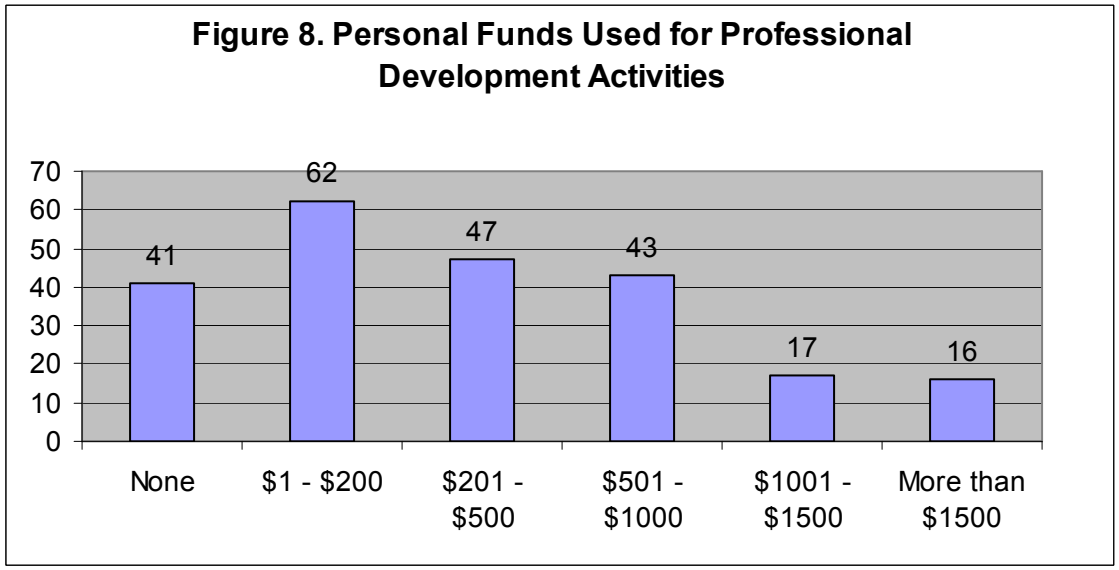
16. Computer Competency/Information Technology (IT) Software skills (PC & Networking): Figure 6 illustrates respondents' computer competency/IT/networking software skills, with 14.2% reporting low-level skills, i.e., they can use application software like MS-word, PowerPoint, Internet browsers, etc.; 49.1% participants said that they have medium-level skills, i.e., they can write simple programs; and 36.7% reported understanding of computer/network systems; and 26.5% reported high-level skills, i.e., they are proficient in programming using high-level languages.



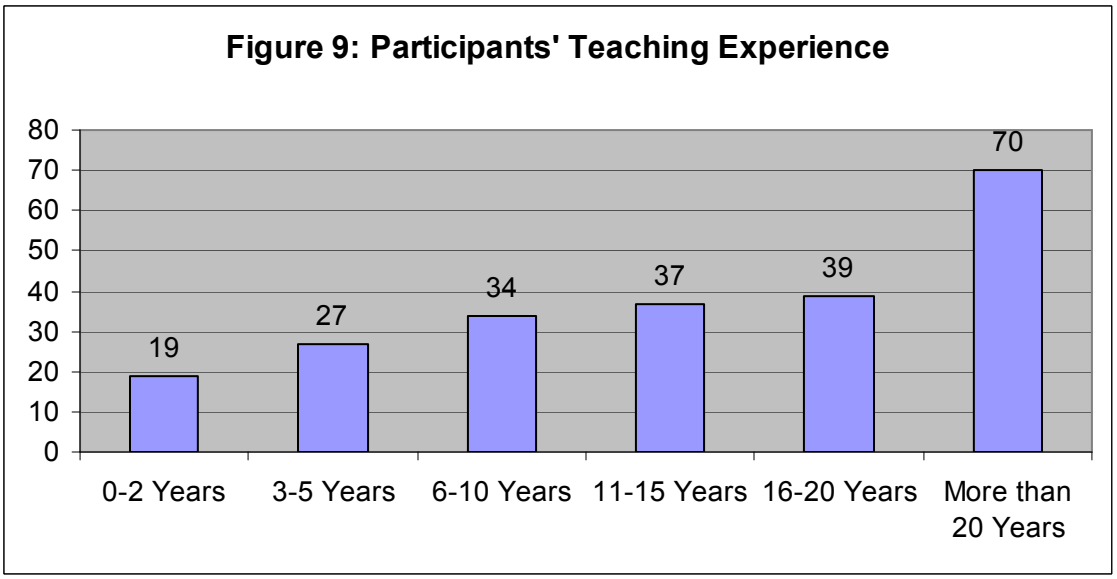
17. Department funds provided for professional development activities: Figure 7 shows the participants' reports of departmental funds for professional development on an annual basis; 17.7% participants reported that no funds were provided for professional development; 20.4% were provided $1 - $200; 20.8% were given $201 - $ 500: 19% were provided $501 - $1000; 16.4% were given $1001 - $1500; and 13% reported that they were granted more than $1500 per year for professional development activities.



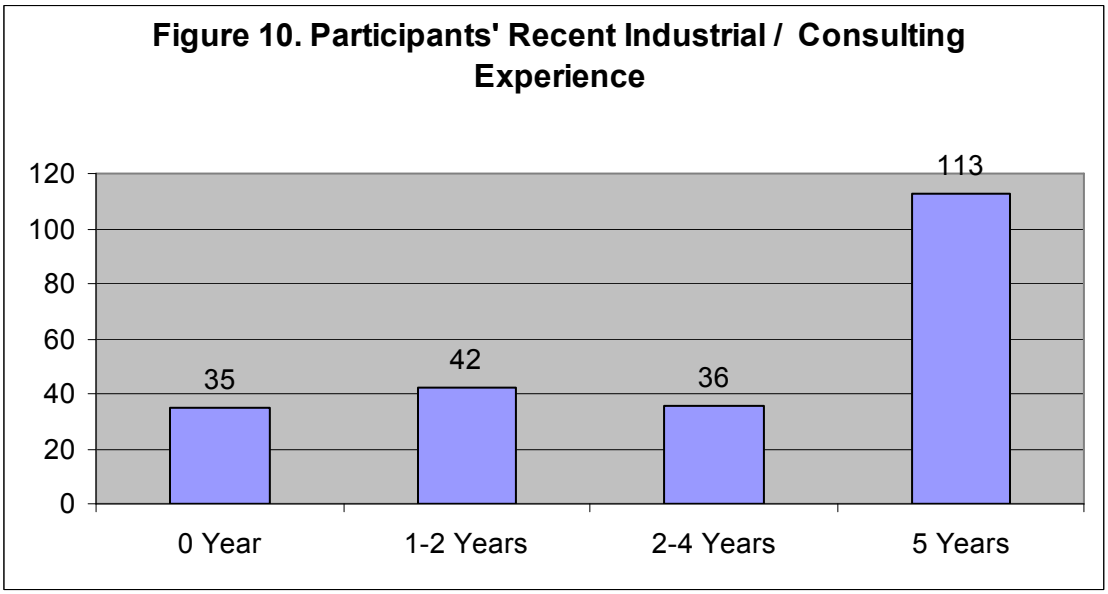
18. Personal Funds used for professional development activities: Figure 8 illustrates the participants' use of personal funds for professional development; 18.1% of participants reported that they did not use any personal funds; 27.4% spent $1 - $ 200; 20.8% used $201 - $500; 19% paid $501 - $ 1000; 7.5% spent $1001 - $1500; and 7.1% of participants said that they used more than $1500 of personal funds for professional development.



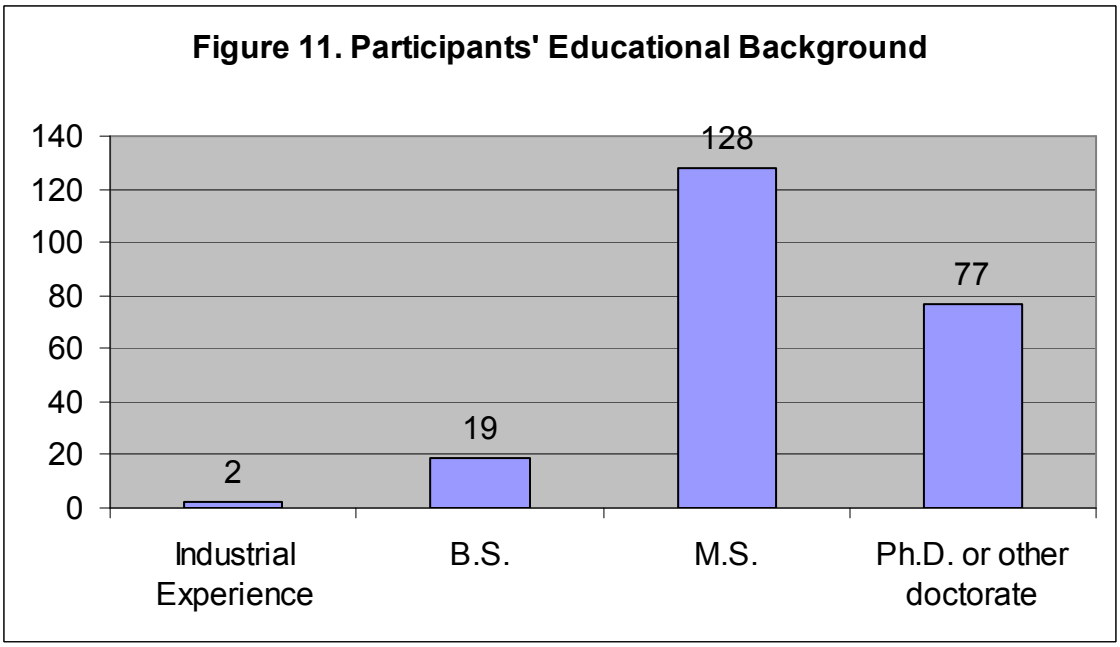
19. Teaching Experience: Survey participants' teaching experience is shown in Figure 9. Thirty-one percent of the participants have more than 20 years of teaching experience; 17.3% have 16-20 years experience; 16.4% have 11-15 years experience; 15% have 6-10 years experience; 11.9% have 3-5 years; and 8.4% have 0-2 years of teaching experience.



20. Recent Industrial/Consulting Experience: Fifty percent of participants reported more than 5 years of industrial/consulting experience; 15.9% reported 2-4 years experience; 18.6% stated 1-4 years experience; and 15.5% reported no recent industrial or consulting experience (Figure 10).



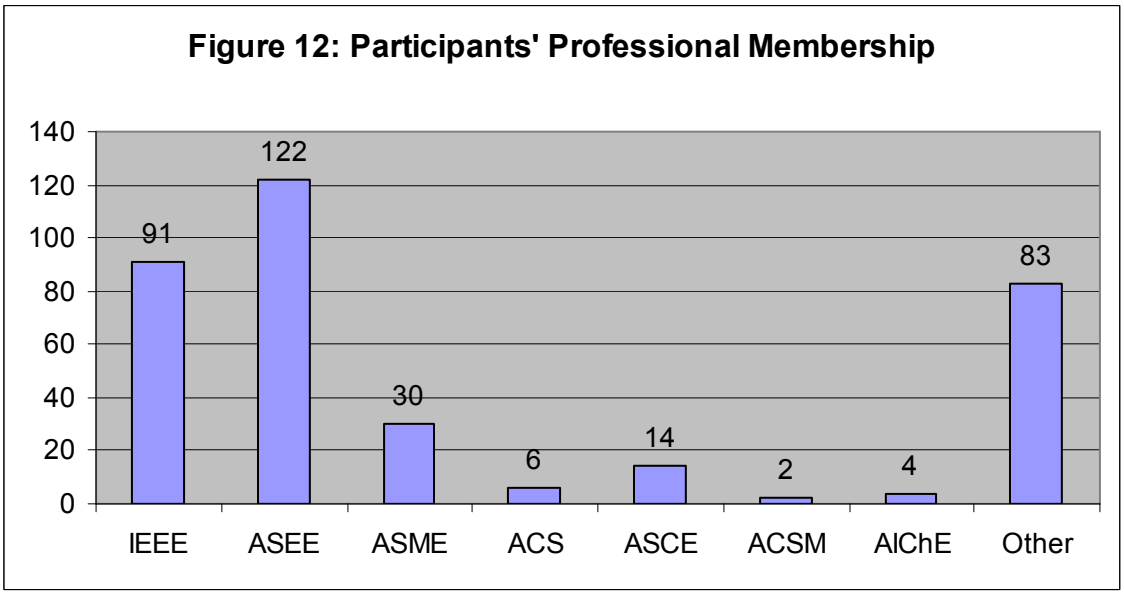
21. Highest educational degree completed: Figure 11 shows the highest degree completed by the survey participants; 34.1% have the Ph.D. or other doctorate; 56.6% have a masters degree; 8.4% have a baccalaureate degree; and 0.9% reported that they have only industrial experience.



22. Institutional expectations for conducting research/publications: Seventy-one percent of respondents reported that they are not expected to conduct research and do publications; and 29% reported that they are required to do so.

23. Gender: Out of 226 respondents, 13.7% were females, and 86.3% were males.

24. Professional Membership: Figure 12 shows the respondents' professional society affiliations.



25. Training in Pedagogy of teaching and learning: Out of 226 participants, 52.7% reported that they did receive training in the pedagogy of teaching and learning, and 47.3% said that they did not receive such training.

26. ***Participants Feedback/Comments regarding the importance of faculty technical currency and faculty development on student learning/success:*** Out of 226 respondents, 24% also completed the comments section of the survey. The following is a sample of selected comments; additional comments are listed in appendix B.

- "This is a highly important topic that receives extremely little attention."
- "Administrators ought to realize the importance of technical currency and professional development of faculty. And in this regard they need to plan appropriate faculty development activities and allocate required funds."
- "I believe it is extremely important. I would also suggest that currency can be attained or maintained through faculty internships (summers) and industry-based sabbaticals."
- "Technical Currency without ability to teach that competency to students is worthless."
- "Close connections to local and regional large companies… would be very useful in terms of transferring technologies, and resources into teaching institutions."
- "Department heads/chairs should realize the importance of technical currency issues via faculty development activities!"
- "Every faculty member should be encouraged to complete several classes from the education department to assist in the development of teaching skills. The skill of teaching young men and women is not automatically obtained…"
- "We need easy and rapid dissemination of best practices as found by educational research centers."
- "Why educate our students to a standard that is ten years old? …Wouldn't it be better to educate our students for the standard that will exist ten years in the future? How can this be done without technical currency?"
- "Resources are the key, you can have all the policies and good intentions you want but if they aren't backed by resources it won't happen!"
- "Community college funding needs to be on par with universities and public school systems in order for faculty to stay technically current."
- "Faculty technical currency and faculty development are absolutely essential for student learning."
- "Faculty technical currency is essential to improvement of the education process."
- "It is very important because industrial applications are constantly changing, and there is a vast overlap of technologies. Also, students need to know of emerging technologies in electronics, computer, and software, mechanical and manufacturing fields."
- "University, industry, and community are in it together. It is very important to have a process/mechanism to retool/upgrade technical currency of faculty. Otherwise the system will be functioning at its minimum and ultimately producing mediocre workforce with numbers."

IV. Predictors for Maintaining Faculty Technical Currency

Regression analyses were performed to explore the relationship between "faculty maintaining technical currency during the last 5 years," as dependent variable, and a number of independent variables used in the survey instrument. Table 3 lists the significant associations. The institutional support and encouragement for maintaining technical currency, and allocation of funds for professional development are the most significant predictors of faculty technical currency.

Table 3. Pearson Correlation Coefficients for Significant Associations for Technical Currency (*N*= 226)

Independent Variables	I believe that I have maintained technical currency during the past 5 years, enabling me to teach courses effectively (Dependent Variable)	Significance Level (Probability, *p*)	Effect Size* (According to Cohen [11])
I believe that there is a strong relationship between the technical currency of the faculty member and student learning/success.	0.21	0.001	Small-medium
My institution supports and encourages faculty members to maintain technical currency.	0.40	0.000	Medium-large
My chairperson supports and helps me plan professional development activities to maintain technical currency.	0.21	0.001	Small-medium
My institution has allocated sufficient funds for the professional development activities of faculty during the past 5 years.	0.32	0.000	Medium
Number of years of recent industrial experience/consulting	0.20	0.001	Small-medium

*Note: Effect size scale, r = 0.05 – 0.15 (small), r = 0.151 – 0.249 (small-medium) r = 0.25 – 0.35 (medium), r = 0.351 – 0.449 (medium-large), r ∃ 0.45(large)

Multiple linear regression analyses were also performed to explore inter-correlations between the dependent variable (faculty maintaining technical currency during the last 5 years), and the following criteria considered as independent/predictor variables:

- I believe that there is a strong relationship between the technical currency of the faculty member and student learning/success.
- My institution supports and encourages faculty members to maintain technical currency.
- My chairperson supports and helps me plan professional development activities to maintain technical currency.
- My institution has allocated sufficient funds for the professional development activities of faculty during the past 5 years.
- Number of years of recent industrial experience/consulting.

The multiple regression analyses revealed that the multiple correlation coefficient (R), using all the predictor variables simultaneously, is 0.486, and the adjusted R square is 0.219 which means that 21.9% of the variance in faculty member's maintaining technical currency can be predicted from the 5 independent variables (faculty member's belief that there is a strong relationship between the faculty and student learning, institutional support and encouragement for maintaining technical currency, chairperson's support to plan professional activities to maintain technical currency, institutional allocation of funds for faculty development, and number of years of recent industrial experience/consulting). This finding is statistically significant.

V. Recommendations

Based on the survey results, data analyses, participants' feedback, and comments, the following recommendations are made for maintaining and enhancing faculty technical currency and faculty development activities in order to improve the quality of instruction in engineering technology programs.

1. Administrators/chairpersons need to realize the importance of technical currency and its relationship to student learning/success.
2. Policies at institutional and departmental level needs to be revised in order to encourage faculty members to maintain their technical currency by planning and pursuing professional development activities.
3. Administrators/chairpersons need to synchronize the curriculum development and revision cycle with the planning and implementation of faculty development activities.
4. Institutions need to allocate appropriate funds for faculty developmental activities. Faculty members should be provided an annual stipends/grants of at least $1000-$1500 for pursuing professional development activities to maintain their technical currency.
5. Institutions need to collaborate with industry for creating professional development activities for faculty. Faculty development grants could be solicited

from industry, and opportunities for short/long term industrial sabbaticals for faculty should also be identified.

6. Institutions also need to realize the importance of the IT/computer competency in promoting student learning. All faculty members should be provided training opportunities to enhance their computer/IT/networking/hardware/software skills.
7. Faculty should be encouraged to pursue industrial experience via mini industrial sabbaticals and consulting work.
8. Administrators/chairpersons need to realize importance of the pedagogy of teaching and learning. And they should provide training opportunities for faculty to strengthen pedagogy in order to improve student learning/success.
9. ABET needs to develop a blueprint for defining and assessing the faculty technical currency so that its program evaluators, school administrators, and faculty can have a better understanding of the construct and its assessment process.

VI. Conclusion

This paper highlights the importance of faculty technical currency. The faculty technical currency survey findings suggest that the majority of the participants believe that:

a. because of the application orientation of engineering technology programs, technical currency of faculty is essential to make student learning more relevant.
b. there is a strong relationship between faculty technical currency and student learning.
c. the institutional support and encouragement for maintaining technical currency, and allocation of funds for professional development are the most significant predictors of faculty technical currency.
d. there is a need to revise institutional/developmental polices in order to encourage faculty to maintain technical currency.
e. there is a need to for the allocation of appropriate funds for professional development activities for faculty.
f. ABET's TC2k accreditation criteria will not necessarily encourage institutions to (i) revise policies that would promote faculty development activities, and (ii) allocate adequate financial resources for faculty development activities.

The rapid growth in technological domains has put new demands on the faculty in the engineering technology programs. In order to narrow the gap between the state-of-curricula and state-of- technology in the industry, faculty are required to revise curricula frequently, and maintain their technical currency. And to improve student learning/success they are also required to learn the pedagogy. This is very challenging, and requires institutional vision, planning, and allocation of appropriate resources.

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Appendix A

Faculty Survey for Technical Currency

Dear Colleague:

As you know, the pace of technological change has imposed new challenges for faculty development and for maintaining currency. We believe that faculty professional development activities and technical currency play an important role in promoting student learning and success. In this regard, we would like to explore the state of faculty currency in the domains of engineering technology. Therefore we invite you to participate in our survey project. To ensure your confidentiality, you are not required to write your name on the attached survey questionnaire. Your participation in this project is strictly voluntary, and information gathered for this study will remain confidential. Answering the questionnaire will not take more than 10 minutes. You can complete this survey online by clicking on the URL: http://www.dpg.devry.edu/~khan/FTCSurvey/ or you can e-mail, fax or mail the attached survey file to us.

We plan to present the results of this survey at the 2004 ASEE conference. We hope that the results of this study will help to improve the quality of instruction in engineering technology programs and lead to enhancing faculty development activities.

Thank you for your willingness to participate in this research study.

Sincerely

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Faculty Survey on Technical Currency

For Questions 1-10, please use the following scale.

1 = I strongly disagree with this statement (SD)
2 = I disagree with this statement (D)
3 = I moderately disagree with this statement (MD)
4 = I neither agree nor disagree with this statement (N)
5 = I moderately agree with this statement (MA)
6 = I agree with this statement (A)
7 = I strongly agree with this statement (SA)

Please circle the appropriate number.

	SD	D	MD	N	MA	A	SA
1. Because of the application orientation of engineering technology programs, technical currency of faculty is essential to make student learning more relevant.	1	2	3	4	5	6	7
2. I believe that there is a strong relationship between the technical currency of the faculty member and student learning/success.	1	2	3	4	5	6	7
3. My institution supports and encourages faculty members to maintain technical currency.	1	2	3	4	5	6	7
4. My chairperson supports and helps me plan professional development activities to maintain technical currency.	1	2	3	4	5	6	7
5. I believe that I have maintained technical currency during the past 5 years, enabling me to teach courses effectively.	1	2	3	4	5	6	7
6. My institution has allocated sufficient funds for the professional development activities of faculty during the past 5 years.	1	2	3	4	5	6	7
7. There is an urgent need in my department/program to improve existing policies in order to allow faculty to enhance their technical currency.	1	2	3	4	5	6	7
8. There is an urgent need in my department/program to increase funding for faculty development activities.	1	2	3	4	5	6	7
9. ABET's new TC2K accreditation criteria will encourage my institution to revise policies in order to promote faculty development activities in order to keep faculty technically current.	1	2	3	4	5	6	7
10. ABET's new TC2K accreditation criteria will encourage my institution to allocate adequate financial resources for faculty development activities.	1	2	3	4	5	6	7

11. How do you stay current (or maintain technical currency) with the pace of technological change? (Check all that apply)

□ Active participation in professional organizations
□ Presenting papers at conferences/writing papers in peer-reviewed publications
□ Attending conferences/technical workshops/seminars
□ Reading books, technical magazines, and trade journals
□ Keeping up-to-date via the Internet
□ Knowledge/skill transfer from senior faculty/colleagues
□ Working as a consultant in industry

12. I am affiliated with a:

□ State supported 4-year university
□ State supported 2-year program/community college
□ Private non-profit 4-year university
□ Private for profit 4-year university

13. My departmental affiliation:

□ Electrical and electronics engineering technology
□ Computer engineering technology
□ Mechanical/Manufacturing engineering technology
□ Industrial engineering technology
□ Civil engineering technology
□ Chemical engineering technology
□ Environmental engineering technology
□ Other_____

14. Do you teach in a TAC of ABET accredited program?

□ Yes
□ No
□ We are in process of getting the accreditation

15. Indicate your computer competency/Information Technology (IT) hardware skills (PC & Networks):

□ Low level (Basic understanding of computer hardware/network systems)
□ Medium level (have understanding of computer/network systems)
□ High level (can design hardware/network systems)

16. Indicate your computer competency/Information Technology (IT) software skills (PC & Networks):

□ Low level (can use application software word, PowerPoint, Internet browsers, etc)
□ Medium level (can write simple programs)
□ High level (proficient in programming using high-level languages)

17. Indicate the amount of departmental funds provided to you annually for participation in professional development activities (conferences, workshops, seminars, etc).

□ None
□ $1 - $200
□ $201 - $500
□ $501 - $ 1000
□ $1001 - $1500
□ More than $1500

18. Indicate the amount of personal funds you spent over the last year for participation in professional development activities (conferences, workshops, seminars, etc).

□ None
□ $1 - $200
□ $201 - $500
□ $501 - $ 1000
□ $1001 - $1500
□ More than $1500

19. Years of teaching experience
    - □ 0-2
    - □ 3-5
    - □ 6-10
    - □ 11-15
    - □ 16-20
    - □ More than 20

20. Number of years of recent industrial experience/consulting
    - □ 0
    - □ 1-2 years
    - □ 2-4 years
    - □ 5 + years

21. Highest educational degree completed
    - □ Industrial experience
    - □ B.S.
    - □ M.S.
    - □ Ph.D. or other doctorate

22. Does your institution expect you to conduct research and do publications?
    - □ Yes
    - □ No

23. Gender
    - □ Male
    - □ Female

24. Professional society membership (check all that apply)
    - □ IEEE
    - □ ASEE
    - □ ASME
    - □ ACS
    - □ ASCE
    - □ ACSM
    - □ AIChE
    - □ Other_____

25. Did you receive any formal training in pedagogy?
    - □ Yes
    - □ No

26. Do you have any comments regarding the importance of faculty technical currency and faculty development on student learning/success?

Appendix B

Participants Feedback/Comments regarding the importance of faculty technical currency and faculty development on student learning/success (Q. 26)

- "Instructors should be encouraged to take one course of their choice per year leading to specialization into a new field so that they can expand their field of teaching. They should be given the opportunity to teach a course in the new field."

- "I believe there is a strong relationship between work experience and student learning. If the faculty can relate the material at hand to what is going on in the work place today the student is more likely to take it seriously."

- "As faculty we really have two areas in need of currency both in our technical specialty and also in teaching. Often faculty, especially tenure track, concentrates too much on the research instead of learning to be better teachers. There is a lot of technology to teaching these days and it is a disservice to our students to not be current in teaching as well as research."

- "Technical currency for my faculty is not funded through institutional resources. Rather, we have developed an industry endowment that takes care of our development needs. Try it; it will really make you independent from politicians and university administrators."

- "We do not have fixed budgets for training or equipment. We can make requests and they may or may not be approved based on need and available funds."

- "The degree of technical currency required is function of the student's technical awareness and ability. Many of the students and most in some schools are woefully lacking in math skills and scientific reasoning. They come from a background where learning is not valued and in some case devalued. The ability to teach such that the students learn the basics of ET is more important than being up on the latest technology."

- "I take full responsibility for my own development. I use primarily self-study and working with industry to keep myself current."

- "Technical currency is important but not critical. In-depth awareness is much more important as we work to establish a firm intellectual foundation upon which our young people may build their intellect and skills... If we prepare a well-rounded engineer with excellent scholastic skills they themselves will seek out those technical advancements we were unable to share with them. A well-developed mind is an inquisitive mind so why not develop the mind placing emphasis on what one needs to know."

- "I would not limit application of specific technical competence to technology faculty only. All engineering and related faculty should be required to operate with real world experience of survival beyond academia."

- "Technical competency is important for ET faculty, but a knowledge and understanding of cognitive science and research is equally important. Too many faculty think that it is easy and simple to teach, but the human mind is the most complex system we will ever deal with!"

- "The faculty MUST be willing to take every opportunity to increase skills, especially in areas that are unfamiliar to the individual faculty member. We have seen a direct benefit to student learning and success when the faculty members are given professional development time and use it."

- "Technology is so rapidly changing that it is difficult to keep up but doing so is a necessity. Guess we just have to bite the bullet because this is what we love."

- "No one at this college realizes they are teaching technology that is at least 20-25 years old."

- "Technical currency is vital, both as a practicing engineer and as an engineering educator. I spend a fourth to third of my time trying to keep current."

- "My dean once said that since we teach a 4/4 load without grad students and have no lab or reasonable library facilities, he does not expect us to do research. As long as we produce a couple of publications each year, he will be happy!"

- "Faculty technical currency is very important but I would rate faculty development and training in pedagogy a little higher in terms of importance to our ET program."

- "Stay current or drag your students slowly down."

- "Faculty technical currency is absolutely critical to student learning/success. I have been teaching for 38 years and I maintain that I have not taught the same course twice because each course is updated and upgraded each term. Technology is changing too fast for faculty members to become complacent."

- "Faculty technical currency, in itself, does not insure student learning/success. However, technical currency combined with good teaching skills will insure the highest probability that student learning/success will take place."

- "Professional development, in my case, has been a personal decision. Sure, professional development is promoted in the faculty agreement with management, but lack of institutional funds is a drawback. Even when external funding is

available, administration will not grant release-time, desiring instead to have faculty remain in the classroom (the mentality that a teacher's place is in the classroom, not participating in professional development activities). Community college administrators are not very wise when it comes to professional development of full-time and part-time faculty. Like managers in industry, they are interested in short-term, not long term, results."

- "Applied research is an important part of the total package of teaching and learning technology. Faculty in technology positions must stay current with the changes in technology, the fundamentals that support the technology and the changing techniques and pedagogy of technical teaching. The challenges are real. Faculty and the administrations need to do more to recognize this need and put specific plans in place to keep academic programs growing and strong."

- "The most frequent requirement that we face is to learn all the new feature of an upgrade of current software, but we are expected to learn this on our own."

- "Technical currency is one of the utmost importance. My community college permits all of the electronics faculty members to serve as consultants…"