Integrating Information Technology into a Biomedical Engineering Technology Program

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Introduction

Biomedical Engineering Technology programs must evolve to continue to provide expertly qualified technicians for Hospitals, Manufacturers, and Vendors. The Biomedical field has traditionally demanded a person with qualifications in the areas of Electronics, Medical Equipment, Mechanical systems, Optics, Medical Terminology, and the sciences to name a few. In recent years, in addition to the qualities mentioned above, the Biomedical Equipment Technician (BMET) has also been called upon to demonstrate expertise in the area of Information Technology. This paper will discuss the method used at Cincinnati State Technical and Community College (Cincinnati State) to accomplish this goal.

Background

We made a commitment to Information Technology education at Cincinnati State, which is in line with the Information technology initiative in the State of Ohio entitled "Itworks.Ohio". [1] "Itworks.Ohio" is a collaboration of business, industry, and educational institutions to provide training in information technology. This commitment made it much easier to provide the information technology training required in the Biomedical program. We were able to utilize courses in place for other programs within the college. This also makes the change much easier to justify from a purely cost standpoint. BMET programs tend to be relatively small in size and costly to run. Justification of a program like this requires cooperation throughout the college and within the local biomedical community.

The need for a BMET graduate well versed in Information Technology, including computer hardware and software, computer networking, and applications in addition to the traditional topics has enabled Cincinnati State Technical and Community College to make significant changes in the Biomedical Electronics Engineering Technology program over the past few years. The Biomedical program at Cincinnati State has experienced a slight decline in enrollment over the past few years. This also precipitated the discussion and eventual changes to the program. Changes were made in the curriculum, course content, and even the name of the program to better reflect what was actually being taught in the course of study.

Our Study

The "Biomedical Electronics Engineering Technology" program is now entitled: "Biomedical Equipment and Information Systems Technology". This name change did not occur overnight. It involved industry advisory committee meetings, meetings with cooperative education (coop) employers, and meetings with student groups. The groups really didn't feel that the name change was a pivotal factor except the students. They felt in talking to their friends, that the word "Engineering" in the title was threatening to prospective students. They also felt that we

were loosing qualified candidates to other programs because of the name. These were candidates with technical and mathematical abilities that simply did not consider themselves Engineering Technology candidates.

Changing the Name

This was a big change to take the word "Engineering" out of the title. The BMET program by any name is still an "Engineering Technology" program. We engaged in additional meetings and it was finally resolved that the name should be changed if for no other reason, a marketing tool. It could mean the life of the program. Our next step was to check with the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC-ABET) and other interested parties, such as institutions with which we have articulation agreements and found that it would be fine to make the change. The name of the program: "Biomedical Electronics Engineering Technology" was changed to "Biomedical Equipment and Information Systems Technology".

The Curriculum

We were now ready to make the curricular changes to the program. The first step was to revise an introductory Biomedical Instrumentation course to contain additional topics in Information Technology. Our course entitled: "Introduction to Biomedical Equipment", became "Introduction to Biomedical Equipment and Information Systems Technology". This enabled us to add topics in computer applications pertaining to the medical field. We now include projects related to computers, computerized information systems, picture archiving, and biomedical databases. These topics are in addition to the traditional topics dealing with department setup, electrical safety, preventative maintenance, hospital organization, and introductory instrumentation to name a few. It will become clear how we were able to add this material as I explain other changes to the curriculum.

The BMET program has evolved over the years to contain fewer courses in analog electronics, particularly courses that involve design of circuits and component level evaluation. Some courses still exist and we still work at the component level, just not as much as before. This seems to be in line with what is happening in the field. They are still doing some component level troubleshooting in industry, just not as much. This reduction opened up time for us to upgrade our efforts in computer related topics.

This upgrade in computer related topics included computer software, computer hardware, computer networking, and medical applications of computers. The program still contains the traditional D.C. and A.C. Circuit Analysis, Motors and Controls, as well as Analog Electronics courses that cover topics that we felt were necessary for a Biomedical graduate to master. We have two advanced courses in Biomedical Instrumentation that contain topics in amplifiers, medical instrumentation, transducers, man/machine interface etc. This enables the student to get additional experience in analog devices specific to the medical field. We also have courses in Microprocessor hardware and software. In response to the infusion of information technologies required of this curriculum, additional courses in computer networking were added. There are a

total of three Computer Networking courses in the curriculum. These courses take the student from basic networking to the latest wireless technologies. (See table 1.)

Table 1. [2]

Biomedical Equipment and Information Systems Technology
Engineering Technologies Division
2002 curriculum

			C	L	B	NT	T
		First School Term (Early Fall '01 or Late Fall '01 Terms)					
MAT	1191	Algebra & Trigonometry 1	3	2	4	0	0
EET	7710	D.C. Circuit Analysis	5	0	0	0	5
EET	7711	D.C. Circuits Lab	0	3	0	0	1
CPET	7728	Digital Combinational Logic	3	2	0	0	4
BMT	7739	Introduction to Biomedical Information Systems and Technology	2	3	0	0	3
BT	9200	Professional Practices	1	0	0	1	0
ET	9400	**First Co-op Term**	1	40	0	0	2
ENG	1001	English Composition 1	3	0	0	3	0
		Second School Term (Winter '02 or Spring '02 Terms)					
MAT	1192	Algebra & Trigonometry 2	4	0	4	0	0
EET	7716	Computer Calculations for Electronics	3	3	0	0	4
EET	7720	A.C. Circuit Analysis	5	0	0	0	5
EET	7721	A.C. Circuits Lab	0	3	0	0	1
CPET	7738	Digital Sequential Logic	3	3	0	0	4
ET	9400	**Second Co-op Term**	1	40	0	0	2
ENG	1002	English Composition 2	3	0	0	3	0
		Third School Term (Summer '02 or Early Fall '02 Terms)					
CHE	2231	Fundamentals of General Chemistry	3	3	0	4	0
IT	5151	Network Communications 1	2	3	0	0	3
EMT	7758	Motors & Controls	3	2	0	0	4
EET	7730	Electronics 1	5	2	0	0	6
CPET	7748	Microprocessor Systems 1	3	3	0	0	4
ET	9400	**Third Co-op Term**	1	40	0	0	2

MAT	1154	Calculus 1	5	0	5	0	0
		Fourth School Term (Late Fall '02 or Winter '03 Terms)					
PHI	1625	Ethics	3	0	0	3	0
PHY	2293	Physics 3 (Algebra and Trigonometry Based)	3	2	4	0	0
MCH	4000	Intro to Medical Terminology	1	2	0	2	0
IT	5152	Network Communications 2	2	3	0	0	3
BIO	4073	Concepts of Biology 3	3	2	0	4	0
ET	9400	**Fourth Co-op Term**	1	40	0	0	2
BMT	7749	Biomedical Instrumentation 1	3	3	0	0	4
		Fifth School Term (Spring '03 or Summer '03 Terms)					
ENG	1010	Technical Writing 1	3	0	0	3	0
SPE	102X	Speech Elective	3	0	0	3	0
ECO	1513	Macroeconomics	3	0	0	3	0
IT	5153	Network Communications 3	2	3	0	0	3
BMT	7759	Biomedical Instrumentation 2	3	3	0	0	4
PSY	1502	Human Relations	3	0	0	3	0
ET	9400	**Fifth Co-op Term**	1	40	0	0	2
					17	32	68
		Total Credit Hours					**117**

Speech Elective: SPE 1020, SPE 1024
C = Class hours L = Lab hours B = Basic credits NT = Non-Tech credits T = Technical Credits.

A Joint Effort

The cooperation that I discussed earlier in this paper involves other departments within the Engineering Technologies Division and the Information Technologies Division at Cincinnati State. We are trying to provide the best possible education for the student while keeping the program within budgetary guidelines setup by the College. We were able to work with other programs to use existing courses and create new courses that would benefit all students in the division. This requires collaboration on course content, lab usage, and course offering times. This enabled us to provide extensive training in Information Technology and make the offering of these courses more efficient. The infusion of Biomedical Students into the courses allowed some relatively low enrollment courses to fill. This is a win-win situation for everyone involved. This also enables us to have collaborative projects between technologies. These courses are now populated with Information Technology and Engineering Technology students who collaborate on projects. This provides additional real world experience from which all students can really

benefit. The biomedical instrumentation courses as well as many of the information technology courses have become project oriented. These courses include not only technical topics, but require students to make oral and written presentations, use outside resources such as the library and internet, provide group reports, and engage in group meetings. The student's assignments are not only graded for technical accuracy but also grammar and spelling. We have found that by starting this process immediately in the program, the students are much more adept at presentations, reports, and communications upon entering cooperative education employment and ultimately graduation.

Cooperative Education

The joint effort concept also expanded to our cooperative education employers. There are 2000 hours of related co-op experience required in the Biomedical curriculum. This is outlined in table 1 above. The co-op experience has always been a hallmark of the BMET program at Cincinnati State. It is very rare for a program to contain co-op or clinical experience to this level. The addition of the I.T. component to the BMET program both enabled and required our employers to provide relevant experience in the I.T. area also.

The BMET program employs a full time co-op coordinator who monitors all positions for relevancy of experience and makes sure that the process runs smoothly. The coordinator performs the task of placing students, conducts exit interviews with all co-op students and employers each term, and strives to make sure that the experience is a good one for everyone involved. This is one way to maintain a quality control for the program. Through this process, we have asked employers to make a conscious effort to provide their co-op students the opportunity to gain this valuable experience.

The interview process also provides immediate feedback to the program that is valuable to the program chairman in making curriculum changes or additions. This working relationship allows us to make very rapid changes to react to changes in the industry.

Items for Consideration

The area of Biomedical Equipment Technology is relatively new. The program at Cincinnati State started in 1970. In that short time the program has evolved as much as any of our Engineering Technology programs. The economy today requires an employee that can justify their existence, provide a valuable contribution, and maintain currency with technology. How are colleges, hospitals, and equipment manufacturers going to cooperate in the future? How will colleges fund these small programs? Recruiting students has gone beyond just the college employee going to high schools, job fairs, etc. Prospective students demand verification from professional in the field that the program is viable and that there are available jobs. The college employee doesn't always have the credibility that prospective students require. Therefore, how will this group recruit jointly? Lastly, are we serving our students well?

Conclusion

This paper suggests that in for a BMET program to survive today, it must be attractive to prospective students, employers, and college administrators. It further suggests that there needs to be collaboration between college departments, faculty, hospitals, and manufacturers to justify the program's existence. We must stay up to date with Information Technology and well as Engineering Technology to produce the BMET graduate that is currently in demand.

References

1. URL: http://www.itworks.ohio
2. Cincinnati State Technical and Community College Catalog

STEVEN J. YELTON; P.E. is currently a program chair in the Information and Engineering Technology divisions at Cincinnati State Technical and Community College. He has been in this position for 19 years. Prior to that, Steve served in positions in industry and also at The Ohio State University. Steve has an Associate of Applied Science degree in Electronics Technology, a Bachelor of Science in Electrical Engineering Degree, and is a Registered Professional Engineer.