2006-1259: OFFERING A SPECIALTY OF ELECTRICAL ENGINEERING TECHNOLOGY TO INCREASE ENROLLMENTS AND MEET EMPLOYER DEMANDS: TECHNOLOGY USED IN THE DELIVERY OF HEALTH CARE

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Biography CHRISTE, BARBARA is an Associate Professor and Program Director of Biomedical Engineering Technology in the Electrical and Computer Engineering Technology Department at IUPUI. She has authored seven on-line classes and is a leader in continuing education for currently-employed biomedical equipment technicians using the web. She has a BS in Engineering from Marquette University and a MS in Clinical Engineering from Rensselaer at Hartford.

Offering a Specialty of Electrical Engineering Technology to Increase Enrollments and Meet Employer Demands: Technology Used in the Delivery of Health Care

Abstract

Electrical Engineering Technology programs can prepare graduates to support the vast array of medical technology deeply connected to the delivery of patient care. Hospitals and medical equipment manufacturers are clamoring for graduates who have combined the practical, technical training a technology program already provides with the vocabulary, regulations and technology specific to the clinical environment. Once an electrical engineering technology program understands the skills requested by employers, faculty can investigate sources of instruction and plan topic coverage. Program outcomes for this specialty are identified. These are tailored to the health care field (with relation to ABET a-k) and will mesh with program outcomes typically in place for existing electrical engineering technology programs. In addition, techniques to offer specialized instruction and several resources to locate potential industry partners will be identified. Examples are provided of two institutions who have successfully expanded their electrical engineering technology programs into this arena are explored as potential models for successful course offerings.

Introduction

"Health care jobs are the result of one of the largest industries in the country, with more than 11 million healthcare jobs and medical jobs…Medical employment and health care employment will account for about 13 percent of all wage and salary positions created between 2000 and 2010. Medical employment and healthcare employment account for 9 out of 20 occupations projected to grow most quickly."[1] With strong advancement, job growth and likelihood of stability, health care is a career area which has found increased focus of educational institutions.

Headlines in a recent healthcare publication announced: "Biomed Shortage Persists, Takes Toll on Facilities."[2] This headline identifies the shortage in "biomeds." This career has many titles but is generally best aligned in the educational environment with Biomedical Engineering Technology programs. However, only a handful of schools across the country currently offer coursework in this specialty. This problem, coupled with the needs of an estimated 2,000 hospitals and outside service organizations, encourages institutions to explore unique educational partnerships. With creative efforts, electrical engineering technology departments have the potential to generate graduates who easily find positions supporting medical technology after graduation. In addition, these students will boost enrollments in existing electrical engineering technology classes.

Educational Outcomes

The EET specialization which serves medical technology has as its backbone electrical engineering fundamentals such as ac and dc circuits, devices, digital electronics, microprocessors and fundamental pc systems and networking. Using these courses already well established can

be a stepping stone towards a new specialty in medical technology support. The initial step in approaching new avenues of instruction encourages the examination of the program outcomes which employers seek from these specialized graduates. A list of the program outcomes from Indiana University Purdue University Indianapolis (BS in Biomedical Engineering Technology) are listed in the following table. The ABET outcomes are defined as "statements that describe what units of knowledge or skill students are expected to acquire from the program to prepare them to achieve the program educational objectives. These are typically demonstrated by the student and measured by the program at the time of graduation."[3]

In order to prepare graduates to support clinical equipment, where do the outcomes of this educational specialty differ from traditional electrical engineering technology (EET) programs? The differences can be categorized in four general content areas. These areas include communication skills for the health care environment, understanding of medical equipment/technology, patient safety and regulations, and experience in the clinical environment. Educational institutions should evaluate their abilities to cover these content areas effectively. Traditional electrical engineering faculty may feel daunted by the material since these topics are unlikely to be within the EET faculty member's realm of expertise. However, departments can successfully meet these program outcomes by accessing resources from within an institution or exploring offerings at other colleges.

Table 1 - Outcomes	
Program Outcome	ABET Outcome[3]
1. Demonstrate knowledge and skills in the use of the electrical and/or computer components of medical equipment systems as encountered in the degree program's courses. Demonstrate a working medical vocabulary and knowledge of clinical safety requirements and regulations as encountered in the degree's program classes.	a. an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines
2. Use current knowledge of mathematics, science and emerging BMET tools to solve problems and demonstrate solutions.	b. an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology
3. Conduct, analyze and interpret experiments, and assess results.	c. an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes
4. Apply and design solutions for issues identified in health care technology as demonstrated in a senior project.	d. an ability to apply creativity in the design of systems, components or processes appropriate to program objectives
5. Function as a member of a 2-4 person team to complete a task in a timely manner. Demonstrate ability to organize work done by team members.	e. an ability to function effectively on teams
6. Identify, analyze and integrate the technical equipment requirements with the needs of medical staff and patients as required in the degree program's courses.	f. an ability to identify, analyze and solve technical problems
7. Write technical reports; present data and results coherently in oral and graphic formats.	g. an ability to communicate effectively
8. Demonstrate skills for life-long learning by locating, evaluating and applying relevant information using external resources such as the Internet, data books, trade publications and library resources.	h. a recognition of the need for, and an ability to engage in lifelong learning
9. Demonstrate ethical conduct as described in the university student code of conduct. Demonstrate knowledge of professional code of ethics.	i. an ability to understand professional, ethical and social responsibilities
10. Demonstrate a respect for diversity as described in the university civility statement. Recognize contemporary professional, societal and global issues in case studies and course projects.	j. a respect for diversity and a knowledge of contemporary professional, societal and global issues
11. Demonstrate quality, timeliness and ability to complete increasingly complex homework and projects throughout the degree experience	k. a commitment to quality, timeliness, and continuous improvement

Resources for Content Coverage

Traditional EET programs may be surprised to learn that they can cover content areas once they employ "out-of-the-box" thinking. There are two major sources for assistance. First, many companies and health care institutions are eager to partner with educational facilities to solve their shortage of potential employees trained to work with health care technology. For example, hospitals can be a source of student internships; the site for hands-on instruction and staff can serve as advisors for career guidance. Creating the link between a traditional EET department and a clinical environment may take perseverance, supportive administration and some luck. However, simply becoming aware of the name of the hospital department to contact can be helpful. Unfortunately, there are many names for the departments which support technology in the clinical environment. These titles include clinical engineering, medical engineering and Biomed. Some institutions still locate their support staff within the plant maintenance and engineering department.

A second source of assistance is corporations which are involved in medical technology. Outsourcing companies such as Aramark, Masterplan, GE and Trimedx are in many of the approximately 2000 hospitals in the country. These corporations understand the value of helping educational institutions and are generally very receptive to local collaboration.

Recognizing that it takes a certain type of person to work in the clinical environment in a service role, the staff of health care institutions is almost always willing to share their knowledge with others. Many clinical engineers also recognize the drawbacks of working in a career field which is almost unknown. Many express their willingness to do whatever it takes to expand the field as well as encourage others to join it.

For each of the content areas, suggestions follow for EET departments to locate resources to cover the material adequately:

Communication Skills for the Health Care Environment
This may be the easiest for most institutions to deal with. While the depth may be more than necessary for EET students, most colleges and universities offer several courses which, together, can form the foundation for graduates to communicate effectively with health care professionals. These courses include: medical terminology, anatomy, physiology and a course related to clinical chemistry (bodily fluids). The greatest issue in this content area is depth. Too much rigor can result in student dissatisfaction and unsuccessful grades. For example, an anatomy course may require students to memorize the cranial nerves. However, in practice, most EET graduates who support medical equipment likely do not need to know this information. However, there may be limited choices of rigor/intensity at an institution. In addition, this content area may be very challenging for traditional EET students who may need to be reminded of the value of this material. While EET students may only need 2-4 courses in this area, the medical staff they will work with (and need to communicate with) have had many years of training in this area.

Understanding of Medical Equipment/Technology

This is likely the most difficult area to cover. The main complaint heard from EET faculty regards the lack of text books written for the technologist who will support equipment. There are two main reasons for this shortage. First, there is a very small market to sell potential texts. Only a handful of schools offer this specialty and most publishers would like to sell large numbers of books. Secondly, medical technology is rapidly evolving; it is difficult to keep a text book up-to-date. As a result, without a text book as a guide, many potential instructors shy away from teaching a class in this area, even when they have the necessary expertise.

A second issue relates to hands on experiences for students on medical equipment. Traditional EET programs are built around laboratory experiments to reinforce concepts. It is virtually impossible for educational institutions to maintain a representative sample of equipment graduates would find in the workplace. Financial, physical and safety constraints limit the practical use of most types of medical equipment. Fortunately, a partnership with a clinical institution can solve this problem. For example, classes can be held at the hospital in the evening when access to expensive important equipment is possible. Again, partnerships play a vital role in this content area.

Patient Safety and Regulations
Fortunately, there is a fair amount of published material available regarding the main regulatory bodies for medical technology. Reference books created by regulatory agencies which are easily understood can serve well as text books for this content area. The Association for the Advancement of Medical Instrumentation is an excellent resource.

Clinical Experience
ABET accreditation has generally required an internship in a clinical environment as part of the educational experience. While the duration and working requirements differ as dictated by local partnerships, hospitals are generally very willing to offer internships and practicum experiences to students ready to graduate. It is very important NOT to substitute internship experiences for content instruction. Internships, while very important, do not replicate the in-depth coverage of content possible in a "classroom" course (although instruction may not be in a classroom).

Two Institutional Models

Two institutions have partnered with IUPUI to expand their EET programs to include instruction in medical equipment support. The process by which they have been successful is described below:

New Mexico State University at Alamogordo
This electrical engineering technology program was well established when the administration urged faculty to look to the health care field to maintain enrollment and meet the needs of employers. A faculty member serves as academic advisor in collaboration with the program director at IUPUI. Students enroll in three courses at NMSU which are contracted and actually offered at IUPUI (using distance education). Students receive credit at their home institution but their tuition is forwarded to IUPUI. This has been very successful for both institutions. NMSU is able to offer a program which it could never have been able to offer without significant capital

and personnel investment. In addition, IUPUI is able to generate much needed revenue. NMSU offers an associates degree in this method.

Fox Valley Technical College
Located in Wisconsin, this school had a certificate already in place in this area as part of their electronics program. However, they were unable to offer the coursework needed. Using the same process as NMSU, Fox Valley has been able to offer the specialized courses needed for their certificate program.

Conclusion

Creative thinking will enable struggling EET programs to offer a specialty which has a huge need for graduates and offers stable career opportunities. Understanding the expectation of employers is vital to looking for alternative instructional resources. Exploring new avenues for coursework, partnerships and collaboration between institutions can ensure that the need for well-prepared graduates ready to work in the clinical environment is possible!

Bibliography

[1] http://www.degreehunter.com/health_care_jobs.html
[2] AAMI News, Oct, 2004, http://www.iupui.edu/~bmet/shortage.pdf
[3] http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/T001%2006-07%20TAC%20Criteria%2012-19-05.pdf