Overview of ABET Accredited Online Engineering/Engineering Technology Programs in the US

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Abstract

The dramatic development of Information Technology (IT) has changed the world and our lives in many ways since the 1990's. One of the important aspects changed as a result of IT technology is how education is conducted. Since the 1990's, the education community has found ways to incorporate IT as a tool to provide online degree programs. But online programs in engineering and engineering technology fields are still few and far between in the US. The authors review the current status of online degree programs in engineering and engineering technology fields in the nation. As an accrediting agency for engineering and engineering technology programs, ABET plays a vital role in maintaining the standards of the accredited programs and making sure that they are continually improving themselves. The authors bring ABET into this topic of online engineering and engineering technology programs by taking a thorough review of the ABET accredited online engineering/engineering technology programs. In this process, the authors explore the challenges faced by online programs in engineering and engineering technology. Using the authors' institution as an example, the difficulties, including administrative and technical ones are explained.

Keywords

Online Education, Engineering, Engineering Technology, ABET.

Introduction

The dramatic development of Information Technology (IT) has changed the world and our lives in many ways since the 1990's. Since 1990's, the education community has found ways to incorporate IT as a tool to provide online education. In 1996, Duke University began its Global Executive MBA program which combined online technology and sessions on-campus and at various location throughout Europe, Asia, and Latin American [1]. Besides the online courses/programs offered by these established higher institutions, IT technology has given many for-private universities tools to compete with traditional universities. In 1999, Jones University became the first fully web based accredited university, though with much controversy [2]. Some other universities, like Phoenix University have successfully made inroads and have attracted students away from traditional universities with their flexible online programs. Currently, with 15% of its total students enrolled online, it ranks 1st as far as having the highest percentage of students online [3].

According to the [1], an online class is defined as "a formal education process in which the students and instructor are not in the same place." For many programs or institutions, their online education has usually started small with one or two courses offered on the web. Then a percentage of the courses in a program's curriculum are offered online, which is sometimes

called a hybrid, until 100% of all the course in the curriculum of a program are offered online. The benefits of online education are obvious. It provides the convenience of learning at home, and students can attend class anywhere as long as there's a computer and internet access. For many working, nontraditional students, online college classes allow them to continue working and tending to their other obligations. In fact, the majority of students at online colleges are working professionals. Online education also gives students a flexible schedule and reasonable demands. Even though the per credit cost for online degree program is usually a little bit higher than that of the traditional, on campus program, students can still save thousands of dollars every semester because they don't need to pay housing fees, commuting costs and other campus expenses that people enrolled in traditional colleges have to pay.

According to [4], the growth of overall enrollments between 2012 and 2013 was 1.2%, increasing from 20,682,643 in 2012 to 20,939,293 in 2013. The year-to-year gain in the number of distance students (189,187) represents 73.7% of the increase in overall enrollments for this time period (256,650). Considering we live in the second decade of 21th century, most students of this generation grew up with the development of IT technology. They are indigenous to this digital era rather than immigrants from a past age. This mode of online education is not foreign to them at all. The education community needs to embrace change and adapt to online education.

From [1], it can be seen that the most popular online degree programs are the following: Business Administration/Management, Accounting, Criminal justice/law enforcement, Finance, Psychology, Graphic design, health care administration, nursing, computer science. Engineering and engineering technology don't make the top 10. Considering that the engineering program is one of the top choices for student on campus, the reasonable explanation is that the popular programs usually don't involve a lot of labs, thus they pose lower barriers for education institutions to offer.

We know that online program or online education is too big a topic for us to cover in this paper. Thus authors confine the paper to 100% ABET accredited online engineering and engineering technology programs. ABET is used as a references because it is a benchmark for the quality of these programs.

ABET

According to ABET [5], "Many academic programs in higher education have at least some content offered online, including individual courses, homework assignments, and class research projects. What constitutes an "online" program is not always well-defined. In addition, the percentage of online content for any academic program changes frequently. The vast majority of ABET-accredited programs are offered mostly on-site." Currently, there are only a few programs accredited by ABET. These programs are offered in a 100-percent online format. For the accreditation of online programs, ABET doesn't have separate criteria. The same criteria for engineering (Engineering Accreditation Commission), engineering technology (Engineering Technology Accreditation Commission), applied science (Applied Science Accreditation Commission) and computer science (Computing Accreditation Commission) is used for accrediting online programs. According to ABET, "We evaluate programs that use a variety of delivery methods: on-site instruction, online instruction, and those having components of both methods.

The programs are evaluated against the same criteria regardless of delivery method." From ABET website, a total of 15 universities have ABET accredited online programs, with total number 19 programs.

Table 1 ABET accredited online programs

	Engineering Accreditation Commission (EAC)		Engineering Technology Accreditation Commission (ETAC)		Applied Science Accreditation Commission (ASAC)			Computing Accreditation Commission (CAC)	
	BS	MS	BS	MS	AAS	BS	MS	BS	MS
Number of degree program	2	2	6	0	1	1	1	6	0

In the following, the authors will choose some programs from the engineering and engineering technology disciplines to discuss. We will look at the details about the online programs, such as their curriculum, delivery method, etc.

Engineering Programs

- Arizona State University [6]

Arizona State University probably has the nation's first online BS EE programs, accredited since 2008, according to ASU website, "The program integrates the fundamentals with practical real-world experience in an online environment. Labs incorporate a combination of practical hardware along with industry-standard design and simulation tools to provide you with the applied skills needed in today's global engineering environment." Student in this program have to complete 120 credit hours. The curriculum sheet of its online BS program is no different from its on campus BS program. At ASU, every program delivered online is developed by the same faculty who teaches on their campuses and is designed to engage students and professors in meaningful ways. ASU students who learn online connect with the full university experience: interaction with internationally recognized faculty, access to collections from ASU's eight award-winning libraries, an alumni network tens of thousands of members strong, and membership in a community of thousands of students pursuing their degrees. According to US News [7], "Arizona State University, a public institution, has been offering online bachelor's degree programs since 2006-2007. All of the online classes are recorded and archived so students can access lecture material at their convenience".

- Stony Brook University [8]

SUNY (Stony Brook) also has an ABET accredited online BSEE program since 2013. According to its website," Stony Brook University's Bachelor of Science in Electrical Engineering online (BSEEOL) degree program provides students with the flexibility and convenience needed to

complete a Bachelor of Science degree in electrical engineering while working full-time." The BSEEOL program is administered by Stony Brook University and courses are taught online by faculty members at Stony Brook University, University at Buffalo and Binghamton University. This program offers upper-division, undergraduate courses, typically offered during the third and fourth years of a four-year undergraduate program in Electrical Engineering. The program is taught completely online, asynchronously delivered for flexible scheduling, and provides all courses, materials, tests, labs, discussions, advising and contact with faculty completely online over the Internet. The online ABET accredited program was originally supported by funding from New York State government to initiate online program among the three campuses, Stony Brook, Birmingham and Buffalo. The three campuses have been collaborating for the last six years to offer online courses in Electrical Engineering. In 2011, the NY State Education Department approved the program as an upper-division Bachelor of Science degree program in Electrical Engineering at Stony Brook University. Faculty from Binghamton and Buffalo continue to support the program by teaching some of the online electrical engineering courses at Stony Brook University as adjunct faculty. The broad objective of this grant is to expand the program and provide online professional engineering education to the technical work force in New York and the nation. To accomplish this overall goal, specific objectives include expanding the offering of high-quality online laboratory courses, seeking ABET accreditation, offering faculty support for online teaching, instructional designs and course development, and providing a model for partnership within SUNY campuses that embraces the Open SUNY concept in which students can take online courses among SUNY campuses as outlined in the Chancellor's Open SUNY Initiative [8]. SUNY's BSEE curriculum requires 120 credits and there's no difference between the online curriculum sheet and on campus program curriculum sheet. The unique thing about SUNY's online EE program is the test policy: "To ensure student authentication, we request students to have exams (mid-term/final) be proctored at testing centers, public facilities or higher education institutions. The following are examples of proctoring facilities. National College Testing Association, the SUNY Exam Proctoring Services, public libraries, community colleges and other higher education institutions. Private proctors especially those who have a personal relationship with the student are not appropriate. Students should obtain approval of the faculty once they have identified a proctoring facility."

From these two engineering programs, it can be seen that both ASU and SUNY also has established ABET accredited BSEE degree programs on campus. In their websites, they both pointed out that all instructors of online degree programs also teach at an on campus program. Thus they leverage their resources like the faculty to set up their corresponding online programs. It is also noted that both ASU and SUNY have many other online programs, besides those mentioned above, across their campuses. Especially ASU, which ranked 11th in US News as the best online undergraduate program in the US. From this perspective, their online engineering programs have the support of their respective institutions, which have built up their knowhow in offering online programs. This knowledge will be key to helping them create ABET accredited online engineering programs. But it is interesting to note that although ASU offers several online technology programs, such as Engineering management, Graphics information technology, information technology, etc. and is considered a powerhouse in engineering technology, it hasn't claimed any ABET accredited online engineering technology programs.

Engineering Technology Programs

- Excelsior College [9]

Excelsior College offers accredited Online Bachelors of Electrical Engineering Technology Degree. The total credits are 124. It has several options, such as digital electronics, microprocessors, control system, etc. It claims on the website that "one of the nation's top educators of working adults, Excelsior enables you to earn an accredited, online electrical engineering degree quickly, conveniently, and affordably." The curriculum sheet is the same as the on campus EET program. No information was found on how the labs are conducted. The instruction delivery method is not known either.

Observation & Discussion

From the limited number of ABET accredited online engineering/engineering technology programs, we can only have a peek of the reality. For the delivery method of the instruction, it seems that Blackboard has been a very popular tool as an online course delivery platform. The asynchronous delivery method is more popular than the synchronous delivery method. ASU will record all the lectures and provide them to online students. Compared with engineering, because of the hands on nature of engineering technology, more labs are included in the curriculum. This unique characteristic makes it harder to offer a 100% online degree program. This can partly explain why an ET powerhouse like ASU, with its university wide online programs, hasn't got any ABET accredited technology programs. Even in engineering technology, different ET programs will have different levels of barriers to overcome. As for EET, because of its equipment-heavy nature, the students need to have access to the different kinds of lab equipment. With the cost of testing equipment coming down and NI's virtual equipment, in the future it may be not as big a barrier as it is today. The student can finish their own labs using the lab kits with the instructor's help, either synchronously or asynchronously.

Our University's Experiences

Use the authors' program as an example, both authors work in the EET department at our institution. Our EET program has been continuously accredited by ABET for more than four decades. Almost twenty years ago, in order to meet the needs of prospective students in south Florida, EET program entered into an agreement with Miami Dade College (MDC) to offer an off campus BS degree program in Miami. After the students got their AA or AS degree at MDC, they transferred to our university without leaving the MDC campus. They took all upper level courses at MDC. Some of the courses were taught by adjunct faculty at MDC; other courses were taught by our EET faculty in the main campus through distance education. EET faculty taught the courses in a typical teleconference setting with a synchronous mode. Both sides used teleconference centers in their respective campuses for the lectures. The faculty and students could see each other in the TV screen. For the lab part of the curriculum, adjunct faculty were depended on to offer labs to the students using the facility at MDC. The quality of the 2+2 program was ensured by the active administration and participation effort of faculty and staff at the main campus. The arrangement benefited both MDC and our institution, and most importantly met the needs of students to further their education in South Florida. The

cooperation lasted almost 10 years before it was suspended. One reason behind the suspension was that MDC was about to start its own BS degree program. Another reason was a concern raised by our reginal accreditation body, SACS (Southern Association of Colleges and Schools). The concern was about the qualification of the adjunct faculty hired at MDC, which prompted the university to take action to suspend the cooperation. In 2009, the authors got a grant from the US Department of Education to build an online tutoring system at our campus. The proposed "Interdisciplinary Remote Instructional Support Center" (IRIS Center) became a hub to link the resources available at the campus and allowed students to receive academic support via a web-based conferencing system. The tutoring was conducted in synchronous mode using "Elluminate Live!". With the help of overhead cameras, smart boards and some other technologies, the tutoring was well received by the both the tutor and tutees. Through the grant, EET program not only built the necessary infrastructure but also gained valuable soft knowledge in online education (tutoring). In 2013, the authors received another grant from the Florida Department of Education to initiate a pilot program with a state college to start a 2+2 program. The expected goal of the grant was to strengthen the collaborations between 2-year state colleges and 4-year public universities in Florida by creating a path way for graduates of AS degree programs to obtain a BS degree through online education. The setup was very similar to the previous MDC collaboration. After the students obtains an AA/AS degree at the state college, they don't need to relocate to Tallahassee. They can stay where they are and take upper level courses remotely. For the lab portions, they will be taught by an adjunct faculty to be hired through the grant using the the facility at the state college. After a decade from the suspension of the MDC campus, with more diverse and mature technology available, there is an obvious advantage to offering course "online" instead of using "teleconferencing". Another advantage is that the state college is only one hour's drive away, which make it possible for main campus faculty to travel to the state college to offer lab courses. Both institutions had a very high expectation at the initial stage of the grant. There were a couple of visits from both side to discuss detail of the project. PIs made a lot of effort to match curriculum of both schools to make the transfer smooth. Admission procedures was developed too. Transfer guideline and special admission for veterans were also developed by the PI. But throughout the process, the interaction of both schools did not get enough attention from high level administrators, which was especially true for our side. The support for this project was limited in a lot of ways. For example, there was not much clerical support. PIs had to shoulder a lot of the burdens. PIs had to make contact with potential students at the state college. PIs also needed to coordinate with the administration of the university for any question related with the online course. The whole process was wracked with a lot of confusion and misunderstanding. Then there's also the issue of a lack of enthusiasm from many faculties. It was expected that faculty would play a crucial role in implementing the grant. First of all, according the university's policy, they needed to participate in the training and obtain a certificate to teach online courses. Faculty would also be involved in developing course material for online education. This was all outside of their regular assignment of responsibilities. Because of the small budget of the grant, with the merger pay they are getting from the grant, they don't have incentive to take the extra work for online education.

Because of these reasons, and the bureaucracy of the administration, the collaboration fell short of offering courses on time as expected. In the meantime, the enthusiasm from the potential

students wore out, eventually they just dropped off from the program completely. The takeaway from our experiences are that strong support, both administratively and financially, is needed to start an online degree program. There is definitely a market for this mode of high education. But there's still a big gap to overcome from a traditional on campus degree to an online degree. For large schools or programs which have more resources, such as number of faculty, financial resources, etc., it is easier to start a mirror online degree program. For small schools or programs, the allocation of resources is a serious issue. It also needs to bring together all the faculty and administration in order to successfully launch an online degree program.

In conclusion, with still much hurdles in the online offering of engineering/engineering technology programs, the authors don't see a big jump or expansion of offerings in online ET degree. Maybe more will be of a hybrid kind of degree program, like the 2+2 agreement mentioned above.

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Dr. Antonio Soares received a BS, MS and PhD degrees in electrical engineering all from Florida Agricultural and Mechanical University. His research focuses on semiconductor devices, semiconductor physics, optoelectronics, and integrated circuit design. Soares also worked for Medtronic as an IC design engineer for 3 years. He joined EET program as a faculty member in 2008. He has made many contributions to the department, from curriculum improvements, to ABET accreditation, and more recently by securing a grant with the Department of Education for more than half a million dollars.