



Maintaining Excellence in Undergraduate Education: The Faculty Development Seminars of the Baylor University School of Engineering & Computer Science (ECS) Over the Last Six Years

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Abstract

“How does a consistently ranked undergraduate engineering and computer science program retain its excellence in undergraduate education, while also aspiring to become an outstanding research institution?” This is a question we posed in 2011, when a series of faculty development seminars were begun as one part of a series of innovations in education made in the School of Engineering & Computer Science (ECS) at Baylor University. It is a question that is of interest to many universities.

Excellence in teaching has always been a hallmark of Baylor. A recent growth in the graduate program prompted the School of ECS to develop a strategy to help faculty, especially research active faculty, see the importance of classroom teaching and to develop classroom skills. This paper will document the original plan to provide tools to enable faculty to grow in both their research programs as well as undergraduate education, focusing on the series of Faculty Development Seminars (FDSs) and end-of-semester workshops held every year since 2011.

The purpose for this work has not changed - as we aspire to encourage innovation in our classrooms and instill a greater appreciation for Baylor, we must, ourselves, continue to grow in our development as faculty, modeling the innovation and appreciation we teach in the very processes by which we teach. We will document the FDSs conducted to date, and provide a longitudinal assessment of the changes introduced through an evaluation of the “before” and “after” courses modified as a result of this work at Baylor University. We will also document the long-term benefits to the School, and will generalize these lessons learned to be adopted/adapted by anyone else.

Introduction

Providing an excellent undergraduate education to students is what every engineering program and any university desires. Engineering programs must compete with other academic units on campus for limited resources in order to make their programs succeed. This is true for Baylor University where the School of Engineering and Computer Science is a less than 10% of the overall undergraduate student enrollment. At Baylor, a five-year strategic plan, called Pro Futuris, was adopted in May 2014. This vision is consistent with Baylor's mission "to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community [1]." The major emphasis of this vision is on increasing the university's research capabilities as part of the vision for growth, which is good news for the School of ECS. One of Baylor's aspirational goals is “Transformational Education.” Many metrics are given to measure this success, such as improved student retention and the aesthetic quality of the campus. These metrics are most definitely student focused. While Pro Futuris calls for academic excellence, not one mention is made of the quality/training of the faculty as part of the improvement process. Faculty development, especially as it pertains to the

classroom, is key to the ongoing quality of any academic program and must be intentionally included in the life of the university.

Faculty development is a topic much studied in the literature. A search of “faculty development” on the ASEE conference paper website returns 19,763 papers from a wide diversity of divisions such Engineering Leadership Development, Educational Research and Methods, Entrepreneurship and Engineering Innovation, and Continuous Professional Development to name a few. Khedkar observed that while the world has experienced a growth in the number of institutions and programs teaching engineering, graduate numbers are not increasing accordingly because of a lack of qualified faculty, necessitating an emphasis on faculty development, especially at the entry level [2]. Reviewing the literature shows the prevailing philosophy regarding faculty development is rather obvious. Faculty development is an ongoing process that should not stop at any level of an academic career, from new hire to a seasoned professor. Khedkar attempts to define faculty development in the university as:

“the process which is undertaken to bring about qualitative changes in the competence of individual faculty members in fulfilling their obligations to achieve the goals and objectives of their institutions [2].”

He applies this definition specifically to the academic environment giving some insight into the results of proper applying faculty development:

- 1) Improved teaching and learning necessary for deep understanding of technical information,
- 2) Implementation of latest teaching strategies,
- 3) Creating practical learning environment provided by laboratories and workshops,
- 4) Effective assessment methods to determine quality and improve the learning process,
- 5) Understanding properly the changing role of teacher in various areas including research [2].

Most universities equate faculty development with a dedicated workshop given either once or twice a year or something that is recurring on a regular basis, often monthly. University of Texas Pan American (UTPA) developed such a program for STEM faculty at two- and four-year institutions of higher education [3]. Their workshop was externally funded and the results extensively documented. Much thought and planning was evident. Success was stated, however, the authors acknowledged that a large stipend was paid to participants and no assessment of impact was made. Garret et al. suggest that these types of workshops are ineffective for several reasons [4]. This is because instructors are not involved in the innovations, little to no effort is made to follow up with instructors after the workshop or seminar, instructors are not provided with enough training and resources to adopt new curriculum during the academic year and these professional development efforts typically focus on universal learning rather than content-specific learning.

Reasons to hold faculty development workshops are presented by Edamana et al. [5]. Faculty, especially new faculty, have many demands on their time. This leads to significant expectations

and much uncertainty concerning what should be a priority for a faculty's time demands. This can lead to a number of conclusions stated below:

1. Expectations for quality with respect to teaching and research have been emphasized in a limited manner through the annual faculty evaluation/recognition awards, but consequences for failure to meet these expectations are not defined.
2. Faculty members have not kept pace with research and development in teaching and learning.
3. Time-efficient ways for members to learn about research and development in teaching and learning and then design approaches to incorporate these findings into their teaching have not been offered.
4. Faculty members perceive reduction of motivation among students for learning, which may have been caused by systemic shortcomings.

Brent et al. outlined the components for a faculty development program in engineering [6]. They state that there must be a faculty coordinator on campus who is either a respected faculty member or an education specialist. Any engineering faculty development must link and be compatible with campus-wide faculty programs. Workshops are learning and networking opportunities and must serve new faculty and graduate students seeking to become faculty. Institutions must support these efforts through release time (especially during the summer), grants, consulting assistance, and travel grants. Faculty development and course improvement must become an important part in the life of the university for every faculty member. The administration must send a clear message to all that effective teaching is highly valued and is a strong requirement for tenure and promotion [7]. With a vibrant faculty development program on campus, Brent et al. highlight the faculty development opportunities in the Engineering Education Coalitions, organizations such as ECSEL, FOUNDATION, GATEWAY, and SUCCEED. Often these organizations are competing for the same membership or attendees for training in the faculty development.

So we come back to the original question, "How does a consistently ranked undergraduate engineering and computer science program retain its excellence in undergraduate education, while also aspiring to become an outstanding research institution?" On Baylor University's campus there are a number of resources that contribute to this goal. The Academy for Teaching and Learning (ATL) has a two-fold mission: globally, to support and inspire a flourishing community of learning; locally, to promote the integration of teaching, scholarship, collegiality, and service in a Christian environment [8]. Approximately twice a month ATL holds special Seminars for Excellence in Teaching which are led by a mix of external and internal speakers. Sessions are open across the campus on a first come-first served basis. Some of these seminars are held over lunch. Another organization is the Institute for Faith and Learning (IFL) whose mission is integrating academic excellence and Christian commitment [9]. As Baylor is a faith based university, IFL adds the spiritual dimension to academics at Baylor University. For instance, IFL recently held a series of lunch seminars/workshops on character development. These two organizations do an excellent job promoting education on campus, however, content is usually generic to appeal to faculty across the campus. These seminars lack a focus on STEM topics and the unique challenges faced by STEM faculty in the classroom.

The original question was posed by Baylor's School of ECS in 2011 and, to begin to address this question, a series of faculty development seminars were begun in the School of Engineering & Computer Science (ECS) to expose faculty to innovations in education. How research universities maintain their teaching quality is a question that is of interest to many universities. Excellence in teaching has always been a hallmark of Baylor University. A recent growth in the number of graduate students and increased emphasis on the graduate program prompted the School of ECS to develop a strategy to help faculty, especially research active faculty see the importance of classroom teaching and to develop classroom skills. The School of ECS Dean supported this effort as a way to instill excellent teaching at all levels, graduate and undergraduate. As a result, a series of Faculty Development Seminars (FDSs) and end-of-semester workshops held every year since 2011. These seminars and workshops are to provide the tools and encouragement for faculty to improve their skills in the classroom

The purpose for these seminars and workshops continues to be to encourage innovation in our classrooms and instill a greater appreciation for Baylor. To be viable for the future we must, ourselves, continue to grow in our development as faculty, modeling the innovation and appreciation we teach in the very processes by which we teach. This paper will make the case for FDSs and document the efforts of Baylor University's School of ECS. We will also document the long-term benefits to the School, and will generalize these lessons learned which could be adopted/adapted by anyone else.

History of the Baylor ECS Faculty Development Seminars

Baylor University was founded in 1848, as a Christian institute of higher learning, and the University has striven throughout the ensuing years "to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community." The School of ECS was formed in 1995, and as was the case for Baylor University, was dedicated to excellence in undergraduate teaching and learning. Over the years, as the University's focus has grown and evolved, the School also deployed graduate programs. As we hired new research-oriented faculty, we strove to maintain our objective of excellence in undergraduate teaching and learning. As the School of ECS continued to grow, our challenge was to maintain this emphasis on teaching and integrate it into the evolving academic culture of research and scholarship.

The genesis of the ECS FDS was formulated in the summer of 2011, through a joint summer sabbatical awarded to the authors to formulate a plan for the inaugural year of FDSs.

Objectives of the ECS Faculty Development Seminars

2011-2012

Our first FDSs were foundational - emphasizing our core competencies in teaching while also integrating the importance of research in our disciplines. In the fall we began by defining these core competencies, with the intent of providing a foundation upon which to build, unifying themes for the School, producing a set of guiding principles that defined the culture of teaching in the School, and providing characteristics by which the School was to be known.

The competencies identified included:

- Christian Identity
- Encouraging Learning Environments
- Student Acceptance/Success
- Teaching/Pedagogy Excellence
- Vision for the Future

We polled the faculty for topics for the spring 2012 seminars, and focused the spring FDSs on balancing life, work, and meaningful service, as well as internships for faculty, and innovations in teaching. The innovations in teaching that were discussed through the semester included working in dense webs of collaboration, entrepreneurial engineering enterprises, and painstorming. For each of these monthly seminars, we invited an outside speaker to come and discuss their collaborative endeavors/opportunities and teaching methodologies.

2012-2013

The fall 2012 seminars continued the trend in ECS Core Teaching Competencies, spending time on assessment, the importance of articulate communication in ECS professionals, and

The spring 2013 seminars focused on the Corporate Intrapreneurship Training program developed at Baylor. This training focused on seven particular areas:

- Strategic Planning
- Product and Service Plans
- Marketing and Sales Plans
- Competition, Strategic Alliances
- Operations, Management, Staffing, Manufacturing
- Financial Plans
- Practice/Final Presentations

2013-2014

The fall 2013 and spring 2014 seminars focused on additional teaching techniques, including:

- Short group projects for concept reinforcement
- Managing team projects
- Discussion-based teaching
- Flipped classrooms
- Writing assessments
- Integrating meaningful experience in a 3-hour lecture course

2014-2015

In the fall of 2014 we focused on the efforts of our Kern Entrepreneurial Engineering Network (KEEN) Innovators, inviting them to share teaching artifacts and pedagogy with other ECS faculty. The KEEN Innovators is a program that was sponsored by a series of on-going grants awarded to Baylor's School of ECS to encourage the inclusion of the entrepreneurial mindset into traditional ECS courses.

The spring 2015 seminars focused on the Five Elements of Effective Thinking (based on the book by the same name by Ed Burger and Mike Starbird) [10]. Included topics:

- Understanding simple things deeply
- Failing to Succeed, or how to welcome accidental missteps
- Creating your own questions (how to create questions and actively listen)
- Looking Back, Looking Forward (understanding current ideas through the flow of ideas, creating new ideas from old)
- Engaging Change

For these seminars, we again opened attendance to other academic units and purchased books for the participants.

2015-2016

The fall seminars focused on creativity, connections, and creating value. The seminars focused on how these concepts were introduced into the curriculum of other academic units. We learned how curiosity in students was encouraged in the study of malaria genomics being conducted in the Department of Biology using backward design. We observed and discussed how connections were formed in the Department of Curriculum and Instruction. We also integrated opportunity with circumstances in a roundtable discussion of how value has been created in business throughout U.S. history.

The spring 2016 seminars were the start of a Baylor School of ECS Working Group of Teaching Innovations. We spent the spring discussing topics of interest to the participants, grouping similar ideas together, and began to design and develop these endeavors. We had 20-25 faculty members consistently attending and participating. Included in this number were tenured, tenure-track, and lecturers. This is approximately one third of the ECS faculty and over half of engineering faculty.

2016-2017

The fall 2016 seminars were a derivative of the teaching techniques disseminated at the Advanced National Effective Teaching Institute (NETI-2) workshop, hosted by ASEE every two years.

Topics discussed included:

- Active Learning - “generally defined as any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing... Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor.” [12]
- Collaborative Learning - “can refer to any instructional method in which students work together in small groups toward a common goal... the core element of collaborative learning is the emphasis on student interactions rather than on learning as a solitary activity.” [12]

The fall topics were a continuation of the NETI-2 topics, adding the following topics:

- Cooperative Learning
 - forming teams
 - implementing cooperative learning
 - assessing individual performance in group work using CATME
 - helping students develop teamwork skills

- Problem-Based Learning (PBL)
 - PBL research base
 - implementing PBL
 - developing a PBL assignment
 - grading rubrics for PBL assignments
 - developing students' problem-solving skills

The spring 2017 seminars were a series of concurrently developed position papers, based on the interest areas developed during the spring 2016 seminars. The topics of these seven position papers were:

- Value of faith-based character development in forming the mindset necessary for a life of service in the professions of engineering and computer science (applying curiosity, connections, and creating value to character development)
- KEEN Workshops/Vision Meetings - developing new areas for the network and sharing experiences through workshops
- KEENternships - giving faculty industrial experiences (to teach the value of the requisite "soft skills" to faculty who may not have had industrial experience)
- KEEN Innovators - a continuation of our Innovators program, where our KEEN Innovators turn around and teach workshops to other schools
- Texas Schools Network - a collaboration of Texas schools, focusing on shared student experiences (design projects and student competitions)
- Curriculum and Co-Curriculum - building interactions between ECS and the Hankamer School of Business, in the classroom and in the Residential College
- Incorporating connections between ECS and the Business School - discussion of business considerations in technical courses

White papers in each of these areas were submitted to KEEN for consideration.

2017-2018

The fall seminars focused on the importance of Team Building and Team Assessment. However, we kicked off the fall seminars with an update on KEEN funding - of the seven white papers submitted, which were deemed of interest to KEEN. This helped focus our efforts on Baylor's Mission in our planning. The fall seminars included:

- KEEN Update, Introduction to the importance of team-related skills for ECS graduates
- Engineering Leadership in Engineering Research Centers
- Attributes of good team members

The fall workshop was facilitated by Dr. Dan Ferguson, Professor of Engineering Education at Purdue University, and Director of CATME. His day-long workshop was a demonstration of the CATME tools and an introduction to some newly deployed tools.

The spring 2018 seminars will revisit Entrepreneurially-Minded Learning (EML), and will include:

- What is the Entrepreneurial Mindset and Why is it so Important for Engineers?
 - Defining the Entrepreneurial Mindset
 - Why is the Entrepreneurial Mindset Important to Future Engineers?

- Integrating the Entrepreneurial Mindset into Existing Engineering Curriculum
 - Being intentional about incorporating the Entrepreneurial Mindset into curriculum
 - ABET Student Outcomes and the Entrepreneurial Mindset
- Where Do We Go from Here?
 - Integrating the Entrepreneurial Mindset as an Engineering Educator
 - Pedagogical and Professional Development Resources
 - Resistance and Change

At Baylor University, these seminars and workshops have become a part of the culture of the School of ECS. At the start of each semester faculty ask when the workshops will begin and look forward to seeing their colleagues and discussion how to become better educators. One indication of the impact of these workshops is that after the CATME workshop, the decision was made to use CATME in both the junior and senior design classes (Engineering Design I and II)

Best Practices in Faculty Development: What Works? What Doesn't Work?

Many institutions have workshops for faculty development and much has been realized on how to make them successful. Brice reports that most new research faculty take between four and five years to become productive researchers and effective teachers [13]. Brent et al. propose purposeful workshops to set new faculty up for success. Their College of Engineering at North Carolina State University have presented these workshops almost continuously for the past 20 years [14]. Workshops are for new faculty orientation as well as mentoring faculty on becoming a good teacher and managing time for a successful career. Buchanan sees this type of development as absolutely essential for the growth of any faculty [16]. New faculty need to know what are the expectations so that they can develop a realistic plan to achieve tenure or have a contract renewed. Jugdev states that faculty development is more important early in a career and a new faculty are severely disadvantaged if this is not present [19]. After 20 years of experience with workshops, Brent et al. offer the following advice on conducting workshops:

1. Keep most of the program within engineering
2. Get administrative buy-in (Deans and Department Chairs)
3. Do whatever it takes to get potential workshop participants to attend
4. Select good teachers as workshop facilitators, and make sure principles of effective teaching are used in workshop delivery
5. Keep presentations practical
6. Involve different faculty members as workshop presenters and panelists to increase awareness about the program
7. Establish and coordinate formal mentoring arrangements for all new faculty members who want them
8. Coordinate activities with campus-wide programs for new faculty and graduate students
9. Make sure that all untenured faculty members are getting regular feedback on their progress toward reappointment, tenure, and promotion
10. Collect data on the program elements
11. Cultivate continued administrative support by reporting to the dean and department heads annually

Typically faculty specify what percentage of their workload is allocated to teaching, research and service. Unless a faculty continually buys-out of their class load, they will have some teaching requirements. Teaching requirements vary from institution to institution with faculty teaching one, two, or three courses per semester depending on the agreements in place. What is desired for a professional educator is to show a constant improvement process that demonstrates proficiency and competency in the classroom. One idea that could encourage improvement is to require faculty to earn continuing education credits, similar to their professional colleagues in industry, to remain current and competent. This would need to have the support of the Administration/Dean and be considered part of the annual evaluation.

Felder and Brent have offered many faculty development workshops worldwide [15]. To get faculty participation, they suggest that institutional incentives be offered, either recognition as part of the tenure process or possibly a monetary incentive or a certificate or plaque. They offer practical advice to people who desire to develop faculty workshops that are effective:

1. Make the workshop content relevant to the participants' courses, students, and problems
2. Include both technical and pedagogical expertise on the workshop facilitation team
3. Emphasize the content relevance and technical credentials of facilitators in promotional materials
4. Keep content practical and ideas easily implementable
5. Be authoritative
6. Don't be dogmatic
7. Call on the participants' experience
8. Be ready for tough questions and difficult (skeptical, hostile) participants
9. Practice what you preach!

It is important at any institution that a culture of educational excellence building community among the faculty must be developed. Han and Herren address this in the context of non-tenure track faculty, often called adjuncts or lecturers [17]. They suggest that the latter titles are pejorative suggesting a second class status in the academic environment. Using the term "teaching faculty" casts these positions in a more positive manner and Han and Herren suggest this be adopted across the profession. Calling the teaching faculty a community of practice might be more descriptive. They suggest some practical ways to motivate teaching faculty to participate and develop of this community, however, these concepts can be related to all faculty:

1. Provide lunch opportunities for sharing of ideas and experiences
2. Offer ideas and experiences that will help faculty develop professionally
3. Build a centralized access to documents, communication, and planning
4. Work with faculty to spread the word about the workshop group within the departments and with newcomers

These four concepts are exactly what is found in the School of ECS concerning the conduct of the seminars and workshops and will continue to be emphasized in the future.

Conclusion

At Baylor University, the faculty development seminars are continuing and are supported by the faculty, with over half the engineering faculty attending. Engaging new faculty is always a challenge. More opportunities for other faculty to lead the seminars and address the faculty should be encouraged. The culture has developed to where faculty at Baylor's School of ECS expect the seminars every semester. Particular lessons we have learned align with the research, including:

- Making the seminars relevant to the teaching faculty (work-life balance, improvements in teaching, practical end-of-semester workshops).
- We have brought faculty from across our institutions, as well as others, to include pedagogical expertise.
- We have invited faculty with relevant course experience and encouraged cross-training.
- We have encouraged all points of view - there have been several instances where the points of view were noticeably different.
- Over the past six years, we have added roughly one third of the ECS faculty to our group, all of whom have incorporated many of the techniques introduced.
- After many years of experience, we know that more faculty will make a point of attending if lunch is served (we tried coffee and snacks, but with diminished attendance).
- All material is posted online, and is accessible to all faculty. In addition, we are developing a website on which the teaching modules will be posted.

It is important to select topics that continue to be relevant to the faculty. Topics must continue to be relevant to the faculty to motivate them to continue to participate [21]. Facilitators must also continually ask the reflective questions that will help maintain the focus and keep the seminars in the context of the Baylor University mission [19]. The research does support that there is a relationship between faculty attending development activities that focus on teaching and the willingness of a faculty to use non-traditional teaching methods [20]. As long as the seminars and workshops continue to fill a need, they will be a part of the ECS culture with improvements and assessment to be made each semester.

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