AC 2012-4885: EXCELLENCE IN UNDERGRADUATE ENGINEERING EDUCATION: THE CHALLENGE FOR RESEARCH-ORIENTED PROGRAMS IN ENGINEERING AND COMPUTER SCIENCE

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Excellence in Undergraduate Engineering Education – The Challenge for Research-Oriented Programs in Engineering and Computer Science

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 difficult proposition, faced by many institutions with mixed results. Clearly, the approach must be intentional in how it addresses the continued emphasis in innovation and excellence in teaching while also emphasizing excellence in research. The faculty of the institution must be given tools to enable them to grow in both of these areas. This paper will address this need by documenting the design and implementation of a series of Innovation in Teaching seminars developed for the engineering and computer science faculty at Baylor University.

At this point in the history of the School of Engineering & Computer Science (ECS), having just developed a school strategic plan, it is extremely important to begin to formulate the philosophy needed to maintain the teaching foundation for years to come. In Baylor University’s history and in our School’s short history, quality and innovation in teaching have been the distinctive that has set us apart. As we continue to grow, however, we must be intentional about maintaining the dual tracks that will continue to set Baylor University apart – teaching and research – and to give our new and current faculty tools to enable them to grow in both of these areas.

This year a series of workshops were designed and developed for the varied needs of the faculty, both experienced and new, in the art and practice of undergraduate engineering education. While the workshops varied from a macro-level discussion of the School’s core competencies in teaching to two day-long workshops in the mechanics of teaching, collaboration was sought across campus lines and across different institutions, leveraging the experiences of those involved in similar endeavors in other academic or administrative units.

This paper will document the benefits to the School including the sharing of “best practices” in teaching the various undergraduate courses, in much the same way as a local version of an ASEE or SIGCSE conference, but with the advantage of being uniquely suited to Baylor University’s culture. The assessment of the effectiveness of this endeavor will be presented, along with plans to generalize these “core values in teaching” for the academic unit’s use in maintaining excellence in undergraduate engineering education.

Introduction

Deficiencies in engineering education have been enumerated exhaustively in recent years by a bevy of panels and blue-ribbon commissions.\(^1\)\(^2\)\(^3\)\(^4\) ABET indicates that we must strengthen our coverage of fundamentals while also

- teaching more about “real world” engineering design,
- covering material in frontier areas of engineering,
- integrating oral and written communication into all facets of the discipline, and
• providing training in “soft skills” such as leadership, management, creative problem
solving, etc.

All the while schools are reducing the total number of hours in the engineering curriculum to
allow the average student to graduate in four years.5 Accomplishing all of this is an impressive
undertaking, considering the approach to educating engineers since the 1950s.6

Add to this mix the desire of Baylor University to grow in its various research areas, and it is
clear that unless emphasis continues to be on quality undergraduate teaching, the demands of the
research paradigm – graduate resources, labs, facilities, students – will dominate the thought and
planning processes of the institution. These challenges, in part, provided the impetus to be
intentional about maintaining the dual tracks that will continue to set Baylor University apart –
teaching and research – and to give our new and current faculty tools to enable them to grow in
both of these areas.

ECS Teaching Seminars

The ECS Teaching Seminars grew out of a desire to refocus on teaching in the School of
Engineering and Computer Science. The challenge that faced ECS is not unlike any university
with aspirations to improve in both teaching and research. Maintaining a high standard and
expectation from the faculty in both areas can at first glance be unobtainable but it is directly
related to the core competencies that the school desires for its students. Baylor University
introduced a 10 year strategic plan in 2002 and in that strategic plan was a desire to develop as a
Research Tier I University. While the Department of Computer Science already had a Masters
Degree, this strategic plan caused the School of ECS to seek masters degrees in Mechanical and
also in Electrical and Computer Engineering in 2004 and, more recently, to pursue PhD degrees.

The Department of Electrical and Computer Engineering was granted a PhD this past academic
year (2011) and the Departments of Computer Science and Mechanical Engineering will be
placing PhD proposals with the administration in 2012. This rush toward graduate programs has
increased the emphasis on research, especially with new hires. Excellent undergraduate teaching
has always been thought of as a core competency of the school however, the emphasis on
research that goes along with the drive for PhD programs and improving the research status of
the University had caused teaching to become less prominent in the school. People talked less
about academic issues in the classroom and this was especially troubling when considering our
new hires. Many of the new hires had not taught before coming to Baylor University and the
concern was that new faculty would not embrace the tradition of teaching excellence for which
the School of ECS at Baylor University was known.

The challenges facing the school are to maintain high-quality undergraduate teaching and
to integrate this into the current academic culture of research and scholarship. As we
continue to grow, however, we must be intentional about maintaining the proper emphasis
that will continue to set apart Baylor University – excellence in teaching and research – and
to give our new and current faculty tools to enable them to grow in both of these areas.
The plan proposed to address this apparent lack emphasis on teaching was to design a series of ECS Innovation in Teaching workshops for all ECS faculty. A main objective of these workshops is to create a culture of academic excellence in the school. This environment will foster a conversation about teaching and enhance the learning experience for our students. While good teaching in no way justifies a lack of student effort to learn the material, good teaching does inspire students to want to know more about a topic. A series of strategic questions were to be addressed when putting these seminars together which in turn provided the framework for implementation:

- Why should someone come to Baylor University to study engineering or computer science (instead of other options for the same degree)?
- What is the importance of teaching in the current Baylor culture (i.e. what is considered the teaching strength of Baylor University)? What will be the role of academic teaching in the future?
- What is the importance of teaching in the current School of ECS culture (i.e. what is considered the teaching strength of the School of ECS)? What will be the role of academic teaching in the future?
- How will research impact academic teaching and academic teaching impact research?
- How will a PhD program influence teaching excellence in the departments?
- What is the future vision for the School of ECS concerning teaching and research five years from now? Ten years from now?
- What will the faculty numbers be five and ten years from now? Student teacher ratio?
- What direction is science and technology headed in terms of classroom instruction/student interaction? What facilities will be needed?
- What does a “successful” faculty member look like at Baylor University?
- How do we “grow” a faculty member from arrival at Baylor University to a Tenured Professor/Senior Lecturer, faculty member?
- What is the role of the spiritual dimension in academics for the School of ECS?
- What responsibilities do we have to our students in the academic environment?
- Where does learning take place? How do we develop learning outside the classroom?

The method of implementing this idea was two fold. First envisioned were a series of “best practices” seminar topics that would address key issues in the school. Also, topics for discussion pertaining to teaching philosophy could be included. These seminars would take place once per month over a 50-minute lunch period with lunch to be provided by the school administration. A second component would be to host “mini-conferences” during one of the Academic Study Days just prior to finals. A Mini-Conference was planned to be held each semester where faculty could present ideas or “experiments tried in the classroom.” These were thought to be 10 or 15 minute presentations followed by a discussion of the ideas by interested faculty or feedback from “experienced” faculty. The Mini-Conference would be a forum for developing ideas and perhaps a way to spark
interest in documenting teaching activities in ASEE papers on both the regional and national levels.

Ancillary to developing these seminars is the necessity to develop a group of academic mentors in each department who could be available in an advisory capacity. Hopefully this is a group of senior faculty with years of teaching experience and a passion for teaching. It is the experience of the authors that, even though most departments have mentors for their new faculty, often these mentors are not necessarily in the academic specialty of the new faculty or the personalities may not be compatible. Unless the new faculty member is asking the right questions, developing a teaching style takes place as a reaction to the classroom instead of an intentional exercise. Therefore, a list of willing, experienced faculty from across the school might be helpful to address specific questions in the classroom. Discussion on teaching is something that should be occurring naturally but does not seem to be in place, especially if the perceived focus of the departments is research. These academic “consultants” from within the school would be available to discuss challenges that new faculty experience in the classroom, or to bring in new ideas to be developed, similar to the concept started with the KEEN Innovators program7,8. It makes a world of difference to bounce ideas off of someone and then refine the ideas. There is also a need to develop, within the school, the freedom to try new things in the classroom because that is how learning occurs and leads to innovation and creativity. In the end we will be better professors if we are open to sharing ideas and adopting the “best practices”. This group of experts would also be desired to be available for observing teaching in the classroom. This could be done informally for feedback for new faculty or it could be done formally for tenure track or lecturer faculty.

ECS Teaching Seminar Topics

When considering the list of possible topics for the ECS Teaching Seminars, the following list was developed through brainstorming and then a survey was sent to the faculty to determine the topics most interesting for the faculty. In the end, the most desired subjects were chosen for the monthly seminars. The list of topics originally considered was as follows:

**Global Topics**
- Baylor University ECS Core Values for Teaching
- New Faculty Workshop to discuss the philosophy of teaching in ECS
- The Use of Personality/Behavior/Motivation Assessment in Retention
- Benefits/Types of International Education for ECS students
- Academic Integrity: How it is enforced and handled in the School and the University
- Value of General Education Courses in the ECS Curriculum
- Balancing Work, Life, and Meaningful Service
- What does a “Master Teacher” in ECS Look Like?
- Juggling Teaching, Research, and Life on the Tenure Track: Navigating the Process in a Christian University
- Valuing Interdisciplinary Research Opportunities
- International Education for ECS Students
- Academic Integrity: How it is enforced and handled
- Juggling Teaching, Research, and Life on the Tenure Track: Navigating the Process in a Christian University
- Credible Methods of Evaluating/Measuring Teaching Effectiveness
- Increasing Faculty Satisfaction within the Academy
- Balancing Work, Life and Meaningful Service
- Importance of Faculty Communication, Community-Building, and Mentoring
- Teaching Students with Different Levels of Academic Preparation in the Classroom

**Classroom**
- New Faculty Workshop to discuss the mechanics of teaching in ECS
- “Best Practices” in Teaching and Assessment
- The Use of Personality/Behavior/Motivation Assessment in the Design of a Good Group Project Team
- Teaching in Large Classes: Ensuring Student Success and Engagement
- What Makes a Good Assessment?
- Collaborative learning in the Classroom
- Technology in the Classroom: What works and what does not
- How and where to Incorporate Active Learning into Courses
- Learner-Centered Teaching
- Grades and Learning: Expectations, Assessments, and Accountability
- Developing Cross-Disciplinary Learning Experiences for Students
- Incorporating and Teaching Global Perspectives
- Promoting Learning through Writing

**Innovation and Creativity**
- Teaching Innovation in Design Courses
- Benefits of/Best Practices in Integrating Innovation and Creativity into standard ECS courses
- The Importance of Innovation and Creativity in the Way we Teach

**Other**
- Role of technology
- Mechanics of teaching (administrivia)
- Testing
- Grading
- Writing
- Assessment
- Peer evaluation
- Business
- Compensation
ECS Teaching Seminar Survey

Before the seminars and Mini-Conferences can be implemented, it was necessary to survey the faculty to determine interest and get feedback on the basic concept to improve teaching excellence. The first item to determine was, “what time would be the best time to hold the seminars to maximize availability?” We didn’t want to schedule this during department meeting times or when most faculty members would not be available. In particular we wanted to encourage new hires (lectures and tenure track faculty) to become a part of this discussion. After the survey a time was chosen that led to maximum availability for the faculty to attend.

A second piece of information to determine from a survey was to poll the faculty for what each person thinks their teaching strengths are and if they would be willing to share with other faculty what they do in the classroom. Faculty in general were not inclined to answer this second question which led to just a few faculty being willing to actively participate with presentations at this planning stage.

The last question asked faculty to identify what strengths they think others in their departments have. Often this type of information is heard anecdotally through students and other faculty. It was hoped that these individuals could then be approached to see if they have are active in these areas and if they would have a desire to share this with other faculty. Unfortunately, this topic was also not answered by people who returned the survey indicating that this information was not widely known. Thus, along with these questions, the faculty was surveyed to determine the general topics that would be of most interest for discussion by the faculty. The response to the survey, while not overwhelming, did give a direction to the ECS Teaching Seminars. The three topics chose for the fall semester were: ECS Core Competencies in Teaching, Academic Integrity Update, and Innovation and Creativity in the Classroom.

Seminar 1 – ECS Core Competencies in Teaching

The overall seminar series had four primary objectives: to intentionally refocus on one of the ECS’s Core Competencies, excellence in undergraduate teaching; to foster cross-disciplinary discussions within the School of ECS; and to promote the development of “best practices” in teaching. This first seminar was aimed at getting the faculty to identify what core competencies in teaching should be important for the School of ECS. Teaching excellence is consistent with Baylor University’s Christian commitment, to do “…whatever you do, you must do all for the glory of God.” (1 Cor 10:31) or “Whatever you do, work at it with all your heart as if working for the Lord, not for men…” (Col 3:23). First a core competency in a team context was defined as “A combination of complementary skills and knowledge bases embedded in a group or team that taken together makes it possible to provide a superior product”9. Defining ECS Core Competencies provides a foundation upon which to build, unifying themes for the school, produces a set of guiding principles that define the culture of teaching at the school of ECS, and provides characteristics by which ECS is known both within and without the university. After a strong discussion on
strengths of the current ECS program, five topic areas were proposed as competencies which encompass all other discussion areas.

The first was Christian Indentify. Baylor University is a religiously affiliated school and this is a key value that makes Baylor distinctive. The spiritual dimension, as part of the Baylor culture, has the greatest potential to impact the student, the community and the world. The challenge is integrating faith and learning in the classroom. A second competency is developing Encouraging Learning Environments. Outlined were the desires to maintain small class sizes with classroom facilities that have the latest technologies. In the classroom, innovation and creativity should be encouraged with activities that provide opportunities for students to learn these traits. Students should be exposed to problem solving opportunities throughout the curriculum. To encourage learning environments, students should have the opportunity to be involved in research projects. A third competency was entitled Student Acceptance/Success. This topic area included faculty mentoring, providing opportunities for student leadership on teams, and demanding respect for students in the classroom. Students should be known for their character and ability to function in the workplace. A fourth competency involves Teaching/Pedagogy Excellence. This is the development of faculty that are not afraid to try new things in the classroom and who engage/encourage other faculty to be the best that they can be in the classroom. Faculty should be engaged in teaching/classroom research and be publishing in avenues such as ASEE. Faculty should also be available for learning opportunities outside the classroom. Lastly, the school of ECS must have a Vision for the Future. This involves being current in the academic discipline and to anticipate the changes in teaching needed to support the changing work environment. What is done in the classroom also must support the mission of the department, school and the university. After a discussion on the competencies, individuals were encouraged to develop a personal teaching philosophy consistent/compatible with the missions of the department, school and university as well as compliment the core competencies within the school of ECS.

Seminar 2 – Academic Integrity Update for ECS

The second seminar was intended to be an orientation to academic integrity for the new faculty, as well as a refresher for the more seasoned faculty. Conducted by the Associate Dean for Judicial Affairs and the Director of the Office of Academic Integrity, the discussion included a brief overview of Baylor University’s policies on Academic Integrity, a discussion of recent classroom cheating methodologies, and an energetic discussion of recent case studies. Among both the new and the mature faculty, this session was one of the favorites. The two presenters adapted their material to the School of ECS, and the question/answer segment was ranked among the highest of the seminars conducted in fall 2011.

Seminar 3 – Innovation and Creativity in the Classroom

This seminar started with a discussion on innovation and creativity to provide the necessary context for the remainder of the session. A definition of creativity was given as:
“Creativity is the ability to produce something new through imaginative skill, whether a new solution to a problem, a new method or device, or a new artistic object or form. The term generally refers to a richness of ideas and originality of thinking. ...Studies also show that intelligence has little correlation with creativity; thus, a highly intelligent person may not be very creative.”

The interesting words in this definition are to “produce something new through imaginative skill” and that “intelligence has little correlation with creativity.” This was new to some faculty and not intuitive. As for innovation:

"Innovation . . . is generally understood as the successful introduction of a new thing or method . . . Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services.”

The key phrase from this definition was the “successful introduction of a new thing or method.” From these definitions it followed that innovation and creativity are linked and the following were given to illustrate this connection:

Innovation typically involves creativity, but is not identical to it: innovation involves acting on the creative ideas to make some specific and tangible difference in the domain in which the innovation occurs.

"All innovation begins with creative ideas . . . creativity by individuals and teams is a starting point for innovation..."

A discussion on the importance of creativity and innovation ensued. These are definitely important qualities for our students in the workplace however, they also are important qualities that we should be modeling for our students. The question of how one gets ideas to be creative in the classroom led to a series of ways to find new ideas, such as a culture of freedom within the school to experiment in the classroom, look to professional societies such as ASEE, SIGCSE, ASME, IMECE, etc., talk to people at other universities, and to learn from our own professors at Baylor University.

Next, this seminar looked at what some professors involved with the KEEN Innovators program are doing in their respective classes to promote innovation and creativity. The KEEN Innovators program is a program which encourages Baylor’s ECS faculty to look for opportunities to incorporate innovation and creativity into their current classes. Six faculty were asked to give five minute presentations on what had been done in the classroom, then a discussion period followed on with questions from the floor. Topics covered included teaching Request for Proposals, patents, competitive learning, ranking tasks, open ended design projects in freshmen engineering, use of wikis and computers, and teaching entrepreneurship. It was great to see small groups of interdisciplinary faculty discussing the presentations after the seminar was over.
At the end of the first semester a three-hour workshop was planned to consist of five 20-minute presentations on topics relevant to the faculty as well as a keynote address by a Baylor faculty member, Dr Ed Burger, the Vice Provost for Strategic Educational Initiatives. Three of the five presentations were facilitated by School of ECS faculty and two were hosted by professors outside the school of ECS.

Presentation 1 – Written Communication
Dr. Lisa Shaver, Assistant Professor of English and one of the instructors of XYZ’s Technical and Professional Writing class, led a discussion on the four things professional audiences expect in workplace writing. Oral and written communication are critical, especially for STEM fields, where technical professionals can spend up to 50% of their time in various communication tasks. She indicated that instructors avoid writing assignments for two significant reasons – time and expertise. They don’t feel they have the time, nor do they feel qualified, necessarily, to assess student writing. The discussion included the following suggestions for the integration of writing into classes:

- Situate writing in the workplace environment
- Ask students to use workplace genres (memos, emails, reports, etc.)
- Evaluate the writing on how effective it would be
- Use clarity, concision, organization and correctness as your rubric

In addition, she suggested two possible writing assignments:
1. Respond to a customer or manager’s question by analyzing data, then write an email or memo.
2. Identify a problem and explain the problem and the action necessary to resolve it, then write an email or memo to a customer, colleague, or regulator.

Presentation 2 – The Importance of Oral Communications for ECS
Dr. Anne Grinols, Assistant Dean for Faculty Development and College Initiatives in the Hankamer School of Business, began the presentation reminding the workshop participants that they are always communicating – talking, listening, body language – and it is the non-verbal communication that dominates the verbal. Some of the critical messages discussed included:

- The speaker is NOT the audience
- Your audience wants to hear less than you want to tell them

Dr. Grinols provided some excellent tips, applicable to the audience, as well as to the students. When communicating, combine verbal and nonverbal communication. First, connect with the audience. Second, convey the information. Third, continue to your next point. When speaking from slides, take the information from the slide, turn to your audience, and tell them the story. Using simple graphics is an excellent way to tell a story.
Presentation 3 – Essential Elements of a Syllabus

This presentation was designed to be interactive among the School of ECS faculty. Three key questions were discussed:

1. What information should be included on the course syllabus?
2. How do we as faculty and students use the course syllabus?
3. How should the course syllabus be made available?

As could be expected, these questions did invoke lots of discussion. Globally, the syllabus was discussed with three main topic areas: syllabus as a contract, learning tool, and permanent record. Key components of the syllabus were discussed. Of particular interest were attendance policies, grading contracts (i.e. individual vs team grades), and how to effectively use the syllabus to help the students be successful. Some variability in the definition of syllabus was evident where some saw the syllabus as a policy letter, others a calendar for the course and others, a combination of the two. In all, the discussion was lively. The last question involved many solutions, from handing out paper copies and having students sign statements saying they read the syllabus to posting this on a wiki and leaving the students to show responsibility. Some discussion was given to letting the students develop their own syllabus at the beginning of class (to include a grading rubric).

Presentation 4 – Writing a good test and assessing the outcome

This presentation focused on one faculty member’s methodology of writing test questions which address the course outcomes on various levels of Bloom’s Taxonomy. A matrix was proposed upon which to evaluate questions to insure all outcomes were met and at the appropriate levels. Time factors were discussed for each question as well to give new faculty some guidelines for test construction. After the test is administered, an analysis of each test question must be done for assessment purposes. Some indication of how easy the question was (did everyone get it right) and its selectivity (did only the top scores for the test/course get the question right) must be made. Another discussion during this session was to keep or to hand back tests with the faculty split fairly evenly on the topic. The benefit to the Professor for keeping the tests was to use good test questions over again. Handing the tests back gave the students more study information. Some faculty kept tests but allowed the students to look at their old exams under a controlled situation prior to the final exam.

Presentation 5 – Engaging Students in the Classroom

This presentation was designed to be interactive among the workshop participants, and was kicked off by a discussion of the latest findings in student engagement research, starting with the conclusion, “Motivation is the portal to engagement.” Current theories about student motivation combine elements of needs and goals models and emphasize the importance of factors within the individual (expectancy x value model).

Several strategies were discussed, including:

- Personalized course delivery – students participate in developing the course learning objectives, building student “buy in”
• Flexible menu of learning activities – giving students choices about how they will implement what they've learned, or how they will be assessed
• Creating a sense of community (especially important for large classes) – go outside, block of an area and verbally mark the boundaries as a small map of campus, have students walk to the location where they live and look around. Students get to know other students who live close, with whom they can form a study group
• Engagement through discussion – have students fill out 3x5” cards with some basic information, shuffle the deck every day, and say, “When your card shows up – and you never know when that might be – you will be the official “questioner” of the day.”

Presentation 6 – Making the Invisible Visible

Dr. Ed Burger, Vice Provost for Strategic Educational Initiatives and Robert Foster Cherry Award Winner for Excellence in Teaching, concluded the fall workshop with a lively discussion of how to further engage students in the classroom followed by a presentation of methods used to deepen students’ understanding, helping them to internalize what they are learning. Critical methods include:
• Understanding – understanding is not binary, there is an entire spectrum of understanding
• Failure Assessment – He routinely makes 5% of final grades weighted on the “quality of failure” of his students, noting that science moves forward only after a series of mistakes. What is important is how the student grows/learns from the failure
• Creating Questions – The art of creating questions is the art of understanding
• Ideas flow from one to another – “Now that you know this, where do you think it leads?”
• Change – Change occurs when we understand, fail, ask questions, and ask “What Next?”

Assessment of Seminar Series and Workshops

At the conclusion of the fall 2011 workshop, the faculty was invited to complete a short questionnaire, indicating which of the seminars/workshop presentations were of most value to them. The following graph indicates how the various faculty members rated each seminar/workshop presentation, on a scale of 1 to 5, which 5 being the “most useful” and 1 being “least useful” (see Figure 1).

Lessons learned from the fall seminars/workshop were also collected, and include some valuable suggestions as the spring 2012 series is developed:
• Devote more time to the workshop presentations (specifically to student engagement, communication skills, and innovation in the classroom)
• Make all presentation materials available (we have established a DropBox site)
• Use more visuals – perhaps develop some short YouTube videos
Next Steps – “Best Practices” for the School

For the spring series, the faculty has been polled, and the following topics will be possible lunch seminars:

- Internships for faculty
- Balancing work, life and meaningful service
- Technology in the Classroom
- Credible Methods of Teaching Evaluation
- Global and Societal Issues in the Classroom
- Teaching Students at Different Levels of Academic Ability
- Weird War Stories from the Classroom

Conclusion

Although a new endeavor for the School of ECS, the Teaching Seminar Series was a success, not only from the standpoint of the attendees, but also from the standpoint of the University and School administration. The Provost approved the summer sabbatical to develop these seminars, and the Dean and the three department chairs attended most of the seminars and all of workshop. Based on the success of the ECS Teaching Seminar Series, and the results of the spring seminars/workshop presentations, the possibility of expanding some of the topics presented will be evaluated. At a minimum, the seminar series has proven to be of great use to the junior faculty of the School, based on feedback from department chairs and the Dean, as well as the faculty members themselves. Further study will be performed to evaluate the optimal forms by which the seminar content should be disseminated.

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1 National Academy of Engineering of the National Academies, Summit Series on the Grand Challenges, www.engineeringchallenges.org
2 "Educating Engineers for 2020 and Beyond," C.M. Vest, talk given at the NAE Annual Meeting, October 10, 2005
14 “The Four Things Professional Audiences Expect in Workplace Writing,” L.J. Shaver, ECS Teaching Seminars – Fall 2011, Baylor University, December 6, 2011
15 “The Importance of Oral Communications for ECS,” A. Grinols, ECS Teaching Seminars – Fall 2011, Baylor University, December 6, 2011
17 "Making the Invisible Visible," E. Burger, ECS Teaching Seminars – Fall 2011, Baylor University, December 6, 2011