
AC 2012-4366: ENGINEERING TRANSFER SEMINAR: A COURSE TO ENHANCE THE ENGINEERING EXPERIENCE

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Introduction

As the American workforce ages and as graduation rates in the STEM disciplines decrease there continues to be a need to attract and educate future engineers^{1,2}. Of specific concern is the ability and capacity of four-year institutions to educate and supply this demand². In an effort to meet the rising demands for engineers, the University of Nebraska-Lincoln (UNL), in partnership with the state's six community colleges, sought to increase the number of community college transfer students entering into the College of Engineering (COE). This effort, leveraged through a National Science Foundation Science, Technology, Engineering, and Mathematics Talent Expansion Program grant (STEP), developed and institutionalized an effective pathway for community college students to complete select freshman and sophomore engineering courses that transfer to the university's COE. However, completing courses for transfer is only part of what is required for a successful transfer experience. It is essential that transfer students, particularly those from community colleges, would experience a smooth transition beyond the transferability of applicable coursework.

Upon admission to the UNL-COE transfer students struggle to integrate into the institution's system. These struggles are exacerbated for students who major in engineering³. Students in mathematics and sciences have higher attrition rates and academic failure/dismissal rates than other transfer students⁴. This is often due to transfer students confronting a campus culture and physical environment different than their prior institution⁵. For instance, transfer students find themselves unfamiliar with the resources needed for a successful transition. Problems arise relating to *how* and *when* credit will transfer, in addition to identifying proper advising. Students are often not prepared for the increased academic work load and the enlarged number of science and engineering courses. Larger class sizes also compounds the issue. Furthermore, learning to adapt to instructors that are more content centric rather than student centric can be problematic. It is also not uncommon for students to experience inadequate financial resources, or strain between familial responsibilities and educational opportunity^{6,7}. Consequently, these challenges have a profound effect on student engagement and retention⁵.

As the receiving institution, it is our intent to ensure that the effects of the aforementioned barriers are lessened so that students will persist and successfully complete a degree in engineering. In response, the decision was made to develop and implement an Engineering Transfer Seminar that would provide transfer students with the means to have a successful transition to the UNL-COE.

The purpose of this paper is to discuss the design, implementation, and purpose of the Engineering Transfer Seminar and its function within the grant. Our objective is to provide a course model for institutions seeking to improve the transition of engineering students from the community college to the four-year institution. The discussion will also include student feedback and current evaluation strategies as well as potential modifications that could be made to add more value for future offerings of the seminar.

Background

The University of Nebraska-Lincoln is a land-grant, research extensive university situated within the heart of the United States, and is a leading contributor to the economic and cultural advancement of the state. For the 2010 academic year, UNL had a total enrollment of approximately 25,000 students. Only 4% of these students were first-time undergraduate transfer students. In the same academic year the COE had an enrollment of approximately 2,600 students and of those students only 5% were first-time undergraduate transfer students⁸. Although this population of students is small the community college system from which they originate will continue to play a more significant role in the development of STEM degree graduates⁹. Therefore, it is imperative that the receiving institution addresses the needs of these students.

Given the expanded role of community colleges in academic transfer education, putting in place a recruitment and retention strategy to encourage more students to pursue education in engineering is imperative. To meet this demand UNL, in partnership with the state's six community colleges sought to increase the number of students successfully pursuing and obtaining baccalaureate degrees in engineering. UNL's partnership with the state's six community colleges fit within the scope of the institution's overall purpose. Furthermore, the partnership fulfills each institution's mission of providing educational excellence for all students, economic and cultural development through research and outreach, and a commitment to diversity and intellectual rigor.

To remove many of the aforementioned barriers to transfer, UNL-STEP developed and institutionalized a pathway of freshman and sophomore engineering courses for students to complete while enrolled at the community college. Upon successful completion these select engineering courses are accepted for credit at the UNL-COE. In addition to courses, academic and social support is provided to ensure retention and encourage completion of a baccalaureate engineering degree in the traditional time frame.

To accomplish the goal of integrating the students through academic and social supports, the proposed action plan was to implement program activities through two strategies. The first strategy was to develop a set of student support activities that included academic, financial, and social components that would facilitate mentoring, community building, and retention. Second, internship opportunities were to be developed to enhance career development and post-graduate career preparation. However, a selection of the student support activities became non-operational. This was due in large part to the different needs that transfer students bring with them to the university that are unlike a traditional student. Transfer students, who are often non-traditional, experience inadequate financial resources and academic preparation, or are often juggling additional responsibilities associated with finances, family, or both^{6,7,10}. Family responsibilities, commuting, enrollment status (e.g., part-time vs. full-time), and economic responsibilities, such as full-time work, are reasons why many of the students who transferred to UNL-COE via the STEP program did not participate in the student support activities. Simply put, they did not have the time.

In theory, the proposed student support activities were designed to eliminate these hindrances. However, after planning multiple activities attendance was poor. It was determined by the UNL-STEP team that because of the unique challenges faced by these students attending these activities were not a priority. Therefore, the UNL- STEP team questioned which format would best fit the needs of the students, taking into consideration their school, work, and familial responsibilities while still exposing them to the importance of community building and career development. According to Ishitani⁵ at many four-year institutions transfer students are not provided an orientation equal to what traditional students receive. Research has suggested that in order to eliminate transfer barriers, student programs that encourage institutional commitment and focus on early student success contribute to retaining this population^{11,12,13,14}.

In response, the UNL-STEP team developed and implemented an Engineering Transfer Seminar Course (ENGR 30) for all newly admitted transfer students. This seminar collectively executes the original strategy that attempted to provide student support activities in the form of various programmatic activities. ENGR 30 is a required pass/no pass, eight week, zero-credit hour course designed to provide transfer students with a variety of tools and resources needed to have a successful transition to the UNL-COE. Students transferring to the COE with 65 or more credits are required to register for and complete this course. Completion of the course is a COE requirement for graduation. Together, the seminar topics relate to academic accountability. However, topics pertaining specifically to academic accountability included the development of academic and professional career goals, student involvement, research opportunities, and study skills. Students participated in assignments that guided them through the process of developing a long-term vision related to their education and career aspirations. With this vision established, they completed an academic and professional development plan that could be shared with his or her academic adviser. Strategies were also discussed for how to achieve an optimal advising experience and the value of having a plan when meeting with an adviser. The COE student services coordinator also provided a discussion on the what, when, where, and why of student involvement. Through this discussion, students learned about various student involvement activities both in and outside of the college. Students were also given insight into the importance of research at UNL and how they can become involved in various faculty research projects. Furthermore, students participated in interactive weekly personal interaction with the instructors on how his or her semester was progressing as well as concerns over recent exams, student organization pursuits, and internship and co-op preparation.

Course Participants

In 2011, 82 students enrolled in and completed ENGR 30. Of the 82 students, 77 (N = 77) completed the seminar evaluation resulting in a 93% response rate. Almost half (48%) of the students transferred from a two-year, traditional community college and 33.8% transferred from a four-year institution. The remaining students identified themselves as international students or second career students. See Table 1 for the transfer status of the students.

Table 1. Transfer Status of Seminar Students

	Frequency	Percent
Not identified	2	2.6
Four year transfer	26	33.8
Two year transfer	37	48.1
International Transfer (Study Abroad)	11	14.3
Second career transfer student	1	1.3
Total	77	100.0

Methods

Course evaluations were administered at the end of the eight week seminar. Evaluations were collected for two semesters: spring 2011 and fall 2011. The evaluations assessed the value of the course and students' perceptions. The items were based on seminar content, course value, and student preparedness. The evaluation contained 9 items scored on a 5-point Likert with 1 = strongly disagree to 5 = strongly agree. Descriptive statistics were applied to examine students' perceptions. The mean score and frequency for each item was calculated.

Findings

Table 2 presents the means, standard deviations, and frequencies of the course evaluations. A discussion about the findings related to course value and student preparedness, along with students' evaluation of the content, will be presented along with a description of the topics in the following sections.

Table 2. Course Evaluation Results

Seminar Topics	Evaluation Item	Mean	Std Dev
University Online Systems	MyRED and DARS presentations provided me with the tools necessary to successfully transfer	4.23	.927
Career development strategies	Orientation to the engineering profession was beneficial to successfully transferring	4.16	.889
Transfer Shock	Identifying and discussing the issues involving transfer shock was beneficial to successfully transferring	3.86	1.129
Developing relationships	Becoming a mature consumer of your advisor was beneficial to successfully transferring	3.87	1.043
Team development	The ENGR survey paper helped me understand the importance, benefits, and the challenges and difficulties of working in a team	3.55	1.130
Course value & student preparedness	Course provided me with the tools and resources needed to have a successful transition	4.05	.841
	I am better prepared to take responsibility for my own education and specific course requirements	3.90	.981
	Students transferring should take ENGR 30	3.87	1.116
	I am better prepared to learn on my own and with others	3.47	1.021

University online systems. University and COE administrators were invited to ENGR 30 to discuss and demonstrate to students how to utilize tools like the degree auditing system (DARS) and MyRED, the academic portal. Both systems are used by students to navigate curriculum requirements, course content, and student information. Introducing students to these tools led to an interactive discussion led by the COE’s Director of Undergraduate Student Advising explaining the nuances of transferring credit and proper course sequence. In Anderson-Rowland, et al’s¹ reflective paper on community college students who transition into engineering, they found that students’ GPA was hindered because they choose to take courses out of sequence so they could take courses based on convenience rather than ability. Additionally, Wheatly, Klingbeil, Jang, Sehi, and Jones’¹⁷ found that once students transferred to the four-year institution they were unable to advance through the first-year calculus sequence and had inadequate numeracy and literacy preparedness. The authors argued that this practice negatively impacted student engagement. Therefore, it was essential to include topics pertaining to course management. When asked if the MyRED and DARS presentation provided them with the tools necessary to successfully transfer, 45.5% strongly agreed and 35.1% agreed. The average score was 4.23 with a standard deviation of .927.

Career development strategies. Students transferring to the COE from community colleges usually do not have a solid awareness of the engineering profession and the requirements for performing in that field. This is evidenced by the focus on very few engineering majors (e.g., Mechanical, Civil, and Electrical Engineering). The COE's Associate Dean of Undergraduate Programs provided an interactive orientation to the engineering profession. This presentation introduced to students what it means to be an engineer, the contributions of engineers as well as future engineering and science challenges, an introduction to the majors that are offered by the COE, as well as the functional roles of engineers in industry and academia. The presentation also included an inquiry into the value of becoming a professional engineer and why students should plan on taking tests such as the Fundamentals of Engineering exam. When asked if the orientation to the engineering profession was beneficial, 40.3% strongly agreed and 40.3% agreed. The average score was 4.16 with a standard deviation of .889.

Transfer shock. Transfer shock is the decrease in a transfer student's GPA during their first semester after transferring to a four-year institution; in comparison to their GPA at their previous institution¹⁵. Cejda, Rewey, and Kaylor¹⁵ found that in comparison to native students, transfer students were more likely to be placed on academic probation as a result of their first semester. These findings were consistent for STEM majors as well. Cejda¹⁶ discovered that students transferring in STEM experience a significantly greater amount of transfer shock than students in other majors.

For a majority of the students ENGR 30 was one of the first courses he or she took since transferring to UNL. Therefore, we felt it necessary to begin the seminar introducing transfer shock. The discussion provided awareness of potential pitfalls and frustrations that can occur to transfer students. To alleviate any potential angst an academic transfer specialist visited with students in class about academic transfer issues. When asked if the transfer shock discussion was beneficial, 39% agreed and 24.7% strongly agreed that the discussion was beneficial to their transfer experience. The average score was 3.86 with a standard deviation of 1.129.

Developing relationships. A significant barrier for transfer students, particularly those who come from community colleges, is negative perceptions that faculty often hold concerning community college transfers. Students also find that relating to faculty in the classroom can be challenging due to larger class sizes and teaching styles that are more content centric rather than student centric. Because of these challenges, students participated in question and answer sessions with a COE faculty member who was willing to share "all that students needed to know about a professor." This discussion addressed the roles and responsibilities of faculty members at a research university. Students were given strategies on how to develop relationships with faculty using a problem solving approach (e.g., identify the problem, the constraints, and the variables) in order to get what they need from faculty. The discussion also addressed perceptions, classroom engagement, navigating conversation, test taking strategies, and general ways of understanding their professor. When asked if the discussion on how to become a mature consumer of their advisor was beneficial, 31.2% strongly agreed and 39% agreed. The average score was 3.87 with a standard deviation of 1.043.

Team development. For the team exercise, students were placed in groups of three to four students for the task of selecting an engineering program offered by the COE and compose a survey paper that would provide an overview of the engineering discipline as well as factors like working conditions, average earnings, and necessary education. Once the teams were created, students engaged in a learning style exercise that enabled students to identify the strengths and weaknesses of his or her learning style and consider how that learning style would potentially affect the team's performance. The purpose of the team project was twofold. First, students were placed in teams based on similar majors. This provided students with the opportunity to develop relationships with their peers with the intent of creating study groups and other support networks. Second, the topic of the paper encouraged students to consider the functional roles of engineers and steps to becoming a practicing engineer. When asked if the team project helped them to understand the importance, benefits, and challenges of working in a team, 19.5% strongly agreed and 39% agreed. The average score was 3.55 with a standard deviation of 1.130.

Course Value and Student Preparedness. The remaining items on the evaluation were centered on the overall value of the seminar and student preparedness. Items included, "The course provided me with the tools and resources needed to have a successful transition," "I am better prepared to take responsibility for my own education and specific course requirements," "I am better prepared to learn on my own and with others" and "students transferring should take ENGR 30." The results indicated that 41.6% of the students agreed and 33.8% strongly agreed that the course provided them with the tools and resources to have a successful transition. The average score was 4.05 with a standard deviation of .841. In regards to taking responsibility for their own education, 48.1% agreed and 27.3% strongly agreed that the course prepared them to take control of their academic career. The average score was 3.90 with a standard deviation of .981. When asked if they were better prepared to learn on their own and with others the results were varied. For, 22% indicated that they were neutral, 46.8% agreed while only 11.7% strongly agreed. The average score was 3.47 with a standard deviation of 1.021.

Lastly, students were asked if future transfer students should take ENGR 30. The results indicated that 35.1% agreed and 33.8 strongly agreed that students should take ENGR 30. The average score was 3.87 with a standard deviation of 1.116. When asked to provide additional comments that might pertain to this item, student comments included:

"Yes, (students should take ENGR 30) as it gives you the outline as what to do and prepare."

"I will put 10 if there is a scale up to that number. Students really need ENGR 30."

Additional comments pertaining to the overall value of the course included:

"This course really helped me gain knowledge of things I need to do."

"This was very helpful for student like me to understand the America engineering culture and education."

"When the advisor advised me to enroll in this course, actually I didn't know why I need to attend. But after a few weeks in this course, it gave me a lot of information to transfer successfully, that's really helpful to me. Thanks a lot."

Future Course Model

For future offerings of the engineering transfer seminar, the inclusion of prior transfer student experiences will be displayed more prominently. The current offerings are currently instructed by a leadership specialist, engineering administrator, and engineering professor; however, course feedback indicated a strong desire for a “survivor” of the transfer experience to play a role in presenting the seminar experience. The ability to have a student role model would be a tremendous added value to the seminar experience. The ideal case would be to have the course instructed by an engineering professor who at one time was a community college student who transferred to a four-year institution.

In terms of course content modifications, the seminar would continue to include information essential to environmental orientation (resource centers, student involvement opportunities, etc.). However, a larger portion of the course would include assisting students identify and associate with students within his or her major. A major target of the instruction would be to instill the student with a sense of belonging to the engineering community that may not be currently expressed. To accomplish this goal, weekly seating arrangements and additional in-class team exercises are potential first steps in this process.

In addition to community college transfer students, an international transfer population could be better served if transfer content was adjusted to meet their needs as well; however, at this time it is still uncertain how the needs of both domestic and international students can best be achieved in an eight week time span.

Evaluation strategies. Current methods of evaluation of value of the engineering transfer seminar have been confined to course evaluations. To provide a more coherent picture of the transfer experience possible tools such as a portfolio could be developed to give students an illustration of where he or she has been and what he or she hopes to accomplish. Also, to evaluate the value and impact of the engineering transfer seminar on retention and attitudes toward engineering, it is the intention of the program to survey classes known to contain cross-sections of engineering students who are native students, transfers who opted out of the seminar, and students who took the transfer seminar.

Integrating interpersonal skills for leadership. Additionally, it is the intent of the program that this transfer seminar could be a suitable platform for developing the interpersonal skills that are typically often criticized by engineering employers as lacking amongst engineering students^{18,19,20}. For future offerings the UNL-COE is currently in development of a leadership and interpersonal skills training experience for engineers that will also satisfy the needs of students transferring from community colleges. Rather than an eight week long seminar, this course would contain the social elements of the transfer seminar as well as provide students will a valuable skill set. It is the hope that through such courses that both community college and UNL will be able to produce students who not only are capable of making a successful transition into the university system but also will develop the skills necessary for transferring to a successful career as an engineer.

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