AC 2011-913: UNDERGRADUATE ACADEMIC EXPERIENCE FOR FIRST-YEAR ENGINEERING STUDENTS THROUGH A SUMMER BRIDGE PROGRAM

Jacqueline Q. Hodge, Texas A&M University

Jacqueline Hodge is a native of Giddings, Texas and currently the Project Manager for the Engineering Student Services & Academic Programs Office (ESSAP) at Texas A&M University (TAMU). In her current position, Jacqueline is responsible for Retention and Enrichment Programs for engineering students.

Jacqueline graduated from TAMU with a Bachelors of Science degree in Mechanical Engineering. While obtaining her degree, Jacqueline was involved with several community service activities such as the Boys & Girls Club of Bryan, Help One Student To Succeed (HOSTS) and Habitat for Humanity. Upon graduation with her bachelors degree, she began work with International Paper Company and became active with the local College Bound Academy as an instructor. While employed with International Paper, Jacqueline obtained her MSBA from TAMU-Texarkana. After 7 years of service in July 2004, she decided to resign her post at International Paper to pursue her masters degree in Mechanical Engineering at TAMU. In Fall 2005, Jacqueline accepted a fulltime position with the ESSAP Office and completed her Masters degree in Mechanical Engineering in May 2006.

Finally, Jacqueline continues to be committed to education and her community. She is the President for the Poplar Circle Neighborhood Association and member of the Brazos valley Area Alumnae Chapter of Delta Sigma Theta Sorority, Inc .

Margaret Hobson, Texas A&M University

Margaret Hobson, Ph.D. serves as an Assistant Director of Strategic Research Development for the Texas Engineering Experiment Station, a state-wide research agency of the Texas A&M University System. In this capacity she works with institutions of higher education across the state of Texas to strategically develop education and technical research proposals that will bring federal research dollars into Texas. Her office has garnered over $66 million in federal funding since 2003 for educational research, in addition to working with faculty who received individual technical awards, such as the NSF CAREER. Dr. Hobson has a B.S. from Texas Woman's University and an M.S. and a Ph.D. from Texas A&M University in Educational Psychology (Dissertation: Teacher Perceptions of Change in Leadership Roles and Activities as a Result of Participation in a Science Education Leadership Program). Her dissertation study was supported by the National Science Foundation project Center for Applications of Information Technology in the Teaching and Learning of Science (ITS Center). Dr. Hobson also has extensive experience in evaluation. Prior to joining TEES, Dr. Hobson taught mathematics and special education in three Texas public school districts between 1976 and 2000.

Bugrahan Yalvac, Texas A&M University

Yalvac received his PhD in Science Education with a minor degree in Science, Technology and Society in 2005 at the Pennsylvania State University. Yalvac worked as learning scientist for the VaNTH Engineering Research Center at Northwestern University for three years before his current assistant professor of Science Education position at Texas A&M University. Yalvac's research focuses on How People Learn framework, science and engineering education, authentic learning environments, cognitive and embodied learning theories, qualitative research methods, and sociology of science.

Magdalini Z Lagoudas, Texas A&M University

Director, Engineering Student Services and Academic Programs, COlleg eof Engineering, Texas A&M University.

Jefferey E. Froyd, Texas A&M University

Jeffrey E. Froyd is the Director of Faculty Climate and Development in the Office of the Dean of Faculties and Associate Provost at Texas A&M University. He served as Project Director for the Foundation Coalition, an NSF Engineering Education Coalition in which six institutions systematically renewed, assessed, and institutionalized their undergraduate engineering curricula, and extensively shared their results with

the engineering education community. He co-created the Integrated, First-Year Curriculum in Science, Engineering and Mathematics at Rose-Hulman Institute of Technology, which was recognized in 1997 with a Hesburgh Award Certificate of Excellence. He has authored or co-authored over 70 papers on engineering education in areas ranging from curricular change to faculty development. He is currently an ABET Program Evaluator and a Senior Associate Editor for the Journal on Engineering Education.

Natela Ostrovskaya, Texas A&M University

Dr. Ostrovskaya is a senior lecturer in the Department of Nuclear Engineering, Texas A&M University.

Tatiana Erukhimova, Department of Physics and Astronomy, Texas A&M University

Tatiana Erukhimova obtained her Ph.D. in Physics from the Russian Academy of Sciences in 1999. She worked as a research scientist at the Institute of Applied Physics of the Russian Academy of Sciences and at Texas A&M University. She is currently a senior lecturer with the Department of Physics and Astronomy at Texas A&M. Her research interests include physics education, physics of the atmosphere, and climate modeling. She is a coauthor (with Gerald North) of an undergraduate textbook on Atmospheric Thermodynamics published by Cambridge University Press (2009). She received two Texas A&M University System Student Led Award for Teaching Excellence (SLATE) and the Distinguished Achievement College-Level Award in Teaching from the Association of Former Students.

Cesar O. Malave, Texas A&M University

Dr. Csar O. Malav is the Associate Dean of Engineering in the Dwight Look College of Engineering and Assistant Agency Director of the Texas Engineering Experiment Station (TEES) at Texas A&M University. He earned a B.S. in Chemical Engineering and a M.S. in Operations Research from the Georgia Institute of Technology. He obtained a Ph.D. in Industrial Engineering from the University of South Florida. He has taught in the Department of Industrial and Systems Engineering since 1987. Dr. Malav's current research interests are on the development of operational planning models for manufacturing systems. He teaches graduate courses and conducts research in the area of manufacturing systems modeling and control. At the undergraduate level, Dr. Malav has taught the freshman introductory course in fundamentals of engineering, engineering economy, manufacturing operations analysis, and robotics. He currently teaches a freshman seminar in the Department of Industrial and Systems Engineering. In the summer, he teaches the Studying Engineering course to students in the LEEP engineering program. In his capacity as Associate Dean of Engineering in the Dwight Look College of Engineering, Dr. Malav leads all engineering efforts in study abroad programs and international agreements. He also serves as the coordinator of academic support activities with the engineering program at the branch campus in Doha, Qatar. Dr. Malav also leads all undergraduate recruitment activities in the Dwight Look College of Engineering including the E12 targeted recruitment program. In his capacity as Assistant Agency Director of TEES, Dr. Malav leads the safety program and the Strategic Research Development group. Dr. Malav is the Co-Author of the recently published book, Global Engineering Design, Decision Making and Communication. He has over 50 publications and has been PI or Co-PI of more than 35 million dollars in sponsored research projects. Dr. Malav is a member of the Editorial Board of the Journal of Applications and Practices in engineering Education, he is also a member of ASEE, IEE, and INFORMS.

Undergraduate Academic Experience for First-Year Engineering Students Through a Summer Bridge Program

Abstract

Research shows that first-time freshmen in general and first-generation college students in particular who are underprepared in mathematics struggle to achieve academic success in engineering programs. Data also indicate that minority students are overrepresented in this group of underprepared students. Across the US, many efforts have been undertaken to help improve all of the college students' academic experiences and engineering retention.

For many years, the College of Engineering at Texas A&M University has focused on initiatives that enhance the academic experiences of freshmen. One of these initiatives, the Learning to Excel in Engineering through Preparation (LEEP) Program, intends to improve students' academic readiness and thus, retention in engineering, especially for students from underrepresented groups. In this paper, characteristics of the LEEP program and lessons learned over four years are described.

Currently, LEEP is a summer program consisting of three (3) credit-bearing courses focusing on mathematics, physics and engineering study skills. In addition to coursework, participants engage in community-building activities with their peers, upper class students, and university faculty and staff. Math SAT (SATM) (or ACT ([ACTM]) scores provide a readily available indicator of students who are likely to be underprepared for the freshman-year engineering curriculum. Based on this indicator, engineering students are invited to participate in LEEP the summer before they enroll in the fall. Fifty-five and 59% percent of the students who participated in the 2010 LEEP program were first-generation and/or URM college students, repectively.

LEEP was first piloted in Summer 2007 and has been offered each summer since. This study reviews four cohorts of first-year students who participated in LEEP between 2007 and 2010. Assessment data includes participants' demographics and their mathematics and physics achievement over the course of the program. The overarching goal of this paper is to share with the engineering community results of LEEP and its positive influence on success of engineering students.

Introduction

Despite improvement initiatives over the past twenty years, retention to graduation continues to be a concern nationwide and for many engineering programs. Nationally, 57% of incoming engineering majors persist to eight semesters.[11] Although persistence rates are similar to other majors, lack of in-migration makes retention in engineering more significant than other majors.[1] Thus, many universities have instituted programs to improve retention and academic success of engineering students.

Summer Bridge Programs: Literature Review

One common type of program is a summer bridge experience. Engineering bridge programs, intended to facilitate transition of students from high school to success in engineering, have been implemented and sustained at many institutions. In a survey of engineering department heads, 45% reported that their department and/or college had some form of summer bridge program.[2] These bridge programs typically focus on incoming (first-year) students and are usually residential.[6] Many, but not all, of these programs are run by engineering diversity program offices or externally funded projects (e.g., National Science Foundation STEP or LSAMP). Most include a significant academic component, especially mathematics content that involves faculty participation.[10] Additional activities develop study skills and social development within the university context.[9] Studies have suggested that many students who enter as engineering majors need significant improvement in study skills,[5] physics knowledge and skills,[4] and mathematics knowledge and skills.[12]

Learning to Excel in Engineering through Preparation (LEEP) Program Introduction

Since 1989, the College of Engineering (COE) at Texas A&M University (TAMU) has implemented various forms of summer bridge programs to proactively address issues of underprepared students and to help students achieve success in engineering. In the meantime, an institutional study was completed that indicated students who achieve a grade of B or better on their first mathematics course are more likely to obtain an engineering degree compared to those with a grade of C or below who are more likely to leave engineering. Then in 2007, the Learning to Excel in Engineering through Preparation (LEEP) program was developed with some components similar to previous summer bridge programs that were focused on underrepresented groups, but also new aspects such as pre- and post-evaluations and a SATM requirement to better address the needs of current incoming engineering students.

LEEP was developed to improve students' academic readiness and, as a consequence retention in engineering, especially for students from underrepresented groups. In general, first-time, first-year engineering students fall into a minimum of one of four groups, depending upon their individual qualifications upon admittance to TAMU and their first semester experience. Historically at TAMU, nearly 60% of the entering engineering majors are either not calculus ready (~20%) or do not pass Calculus I in their first semester (~40 %). Therefore, there are hundreds of students that could benefit from initiatives to improve their likelihood of success in Calculus I. LEEP is one step initiated to address this issue for a carefully characterized group of students.

LEEP History and Program Description

The LEEP program was initiated in 2007 as a five-week summer bridge program for incoming freshman and primarily served minority students who were admitted to the College of Engineering. In its inaugural year, LEEP mainly focused on students with SATM scores between 400 and 600 (ACTM score at or below 24). The overarching goal was to enhance their mathematics skills and improve their retention in engineering.

A non credit-bearing, pre-calculus course and weekly study skills workshops were offered to LEEP participants. The mathematics course was taught by a COE lecturer and the study skills workshops were conducted by the TAMU Student Counseling Services. In addition to strengthening their mathematics skills and study behavior, participants had the opportunity to earn 3 credit hours of course electives towards their degree programs; understand the importance of the engineering profession to society; build relationships with peers; become familiar with TAMU facilities, services and housing; earn performance-based, monetary incentives and act as ambassadors to peers who did not participate in program.

Many lessons were learned from the 2007 cohort. There was evidence that many of the students did not value the non-credit bearing, pre-calculus course even though monetary incentives were provided for achievement of specific objectives. In addition, at the conclusion of their fall semester, participants were polled with respect to courses they would have wanted offered during LEEP and many indicated that better preparation for physics would have been beneficial. Furthermore, faculty members in the TAMU Department of Physics noted that first-year students do not perform well in physics if their calculus skills are deficient.

In Fall 2008, based on the above observations, LEEP was modified to include a credit-bearing, pre-calculus course and a non-credit, physics course. In addition, a study skills course specifically for engineering students replaced the Student Counseling Services study skills workshops. This course was non-credit bearing to keep the direct cost of LEEP to students at a minimum. Also, the COE implemented a minimum SATM of 550 for all incoming freshman for Fall 2008 and the LEEP admittance requirements were changed to target students with SATM scores between 550 and 600. This version of LEEP was offered in 2008 and 2009.

LEEP 2010 was further modified based on additional observations and student input. To maintain a reasonable enrollment, the SATM requirement was lifted with belief that all students could benefit from LEEP and taking into consideration the award-winning Georgia Tech Challenge Program's criteria was similar.[3] The elective (International /Cultural Diversity and Visual/Performing Arts) course was eliminated because many students found it difficult to maintain focus on the mathematics, physics, and engineering study skills courses. LEEP 2010 offered three credit-bearing courses: Engineering Mathematics (ENGR 289-201), Engineering Physics (ENGR-203) and Engineering Study Skills (ENGR 289-202).

The LEEP Courses

LEEP Engineering Mathematics Course. The LEEP math course objectives were to 1) reinforce, broaden and extend mathematical knowledge/skills; 2) prepare for Engineering Mathematics (Math 151) and Physics (PHYS 218) courses; 3) develop/improve problem-solving abilities/skills through experience in a design project; and 4) recognize the importance of mathematics to engineering. Topics included fundamental concepts in algebra (exponents and radicals, algebraic and rational expressions, equations and inequalities, systems of equations) and planar geometry, elementary functions (polynomial, rational, exponential, and logarithmic), trigonometry, vectors and an introduction to engineering design. The LEEP math class was taught by an instructor from the College of Engineering who also teaches the "Foundations of Engineering" course to first-year students.

Daily math preparation activities included a two-hour class with a short (up to 20 minutes) quiz at the beginning of each class. The short in-class quizzes were based on the material covered in a previous homework assignment. Students were required to attend two-hour study sessions that were proctored by the instructor, a teaching assistant and two peer mentors. These study sessions occurred five days a week. One and a half-hour exams were given at the end of each week to evaluate each students' progress. In addition, the participants were assigned a design project that was aimed at improving students' problem solving skills. The class was divided into teams of four students. The groups were asked to design a play house for a theme park (i.e. a "Math Kingdom" park). Students were provided with specifications expressed in terms of parameters. To perform calculations and satisfy design constraints, students were expected to use all topics (except for vectors) covered in class. Students built a cardboard model to scale (1:10) of the playhouse and presented their design to the entire class.

New first-year students entering an engineering program at TAMU are required to take the math placement exam (MPE) prior to attending their New Student Conference.[14] Students cannot register for any math course until they complete the exam. This examination was designed to measure students' pre-calculus skills. The test scores are reported to the undergraduate advisors and used (with the SATM or ACTM score) to determine which mathematics course a student should take in his or her first semester at TAMU.[15]

The LEEP math instructor used these scores to identify strong and weak areas for every LEEP student. The majority of the students took an algebra/pre-calculus course in their junior or even sophomore years in high school. After being out of practice for a whole year, they simply forgot their algebra skills. Even if students took a calculus course, they typically would only remember and would do straightforward, one-step problems using formulas (i.e. "plug and chug"). Many students had a rather poor understanding of logarithmic/exponential functions and trigonometry. Participants struggled when they needed to work with symbols and not numbers; they had a rather difficult time solving word problems.

Starting in 2009, a new LEEP admission requirement was added: students had to complete a set of college algebra homework assignments before they arrived on campus. Homework problems were selected from the College Algebra/Pre-calculus Tutorial developed by the TAMU Department of Mathematics.[13] These exercises helped students to brush up on basic algebra skills

before the intense LEEP math program started. Students submitted their work electronically and received prompt feedback.

At the end of the program, the students took the MPE again. The math placement score and the grade in the LEEP math class were used to determine which mathematics course a student should take in the following fall semester.

LEEP Engineering Physics Course. Most students admitted to the COE are required to take an introductory physics class, PHYS 218 (Mechanics), during their first year. This is a difficult course loaded with new physics/math concepts and presents a serious challenge for many first-year students. Unlike many high school physics classes that overuse the "plug and chug" approach, the PHYS 218 class requires proficiency in both algebra and calculus. The course also emphasizes problems that cannot be solved with problem-specific formula sheets. Students are expected 1) to figure out for themselves what concepts and laws are to be used for a given problem and 2) to derive a solution in a **symbolic** form using advanced college math. Succeeding in this class requires a lot of dedication, responsibility, and hard work during the semester.

The goals of the LEEP physics course were to 1) prepare students academically for the rigor of the Physics 218 class by bringing them up to the level of well-prepared students who succeeded in advanced physics and math classes in their high schools and 2) help students develop the level of commitment needed to succeed in the freshman year physics classes.

The LEEP course is taught by an instructor from the TAMU Department of Physics who also teaches two introductory freshman classes for engineers: PHYS 218 and PHYS 208 (Electricity, Magnetism and Optics). The material covered in the LEEP course included vector algebra, free body diagrams, introduction to calculus (differentiation and integration of power functions), kinematics, Newton's laws, and torques. The emphasis in the class was on problem-solving. All problems on quizzes and exams were given without numbers and students had to determine the answer in a symbolic form.

The physics course was administered differently in summer of 2010 compared to summers of 2008 and 2009. In 2008 and 2009 students had an hour-long physics class every day, daily homework to master the topic covered in class, weekly quizzes, and entry and exit exams.

In 2010 the number of physics classes was doubled. Three labs were added to the course. The labs were similar to what students would have in the regular mechanics class. The selected labs were chosen to help students in understanding vectors, forces, torques, static equilibrium, and derivatives. They worked in teams on each lab and learned how to submit a lab report. Three exams given over the course of 5 weeks measured the weekly progress of students' understanding of the concepts. Students attended help sessions proctored by the instructor before each exam.

Entry and exit benchmark tests were given in the beginning and in the end of LEEP. The students were given the entry test in order to get some indication of their knowledge of basic elements of mechanics. In 2010, of the 22 incoming students only two received a score signifying any mastery of the material. The average score, out of 100, was less than 20 with a median score less

than 4. The results of the exit test, a final exam covering all the material in the course, were inspiring. After completing the LEEP Physics course a student was deemed ready for Physics 218 if he or she passed the exit exam at the 70% level. This implied that the participant had learned just what level of effort would be required, certainly individual for each student, to master the material. It also served as an indicator of students who exhibited commitment to putting forth the required effort to continue mastering the material in the fall. The average score was 86 out of 100 with a median score of 90. The recommendation to have the students take or delay taking Physics 218 was based solely on the performance on the final exam. Only 3 out of the 22 did not perform well enough to earn a recommendation to go on to Physics 218 in the Fall.

Student performance on the exit test in 2010 was significantly better as compared to 2009 when the number of physics classes was two times lower than in 2010 and there were no labs. The average score on the 2009 exit test in physics was only 60 out of 100 with a median score of 54. Only 11 out of 26 students were recommended to take Physics 218 in the Fall 2009.

LEEP Engineering Study Skills. Studying Engineering by Raymond B. Landis[7] was the course text. The main objective of the study skills component of the LEEP Program was to prepare students for the rigor and challenges of the first-year in engineering. Students learned and practiced the skills necessary to be successful engineering students. These skills include time management, effective communication, dealing with different learning and teaching styles, and effective study. Students also got a detailed picture of the engineering profession – from the history of the different fields to the role of creativity and innovation in the formation of engineers for the 21st century. An important element of the study skills component was the use of active and collaborative learning as a delivery method for the course. Students worked independently and in teams in the classroom. Students worked collaboratively on exercises mostly related to common mistakes and pitfalls that could derail the academic career of engineering students. A significant amount of effort was also dedicated to transitions between high school/college and transformations that must occur in order to become an effective/efficient college student.

Efficacy of the LEEP Program

The study participants comprised 117 students. The data was collected over four years: 2007, 2008, 2009, and 2010. Student demographics are presented in Table 1. For each cohort, the majority of the population was comprised of students from underrepresented minority (URM) groups except 2008 and 2009. The URM participant make-up was 56% in 2007, 50% in 2008 and 2009, and 59% in 2010. In 2010, a concerted effort was made to recruit more URM first-year students, due to the COE SATM requirement. Priority admission was given to students who attended one of the COE's signature recruiting program's high schools and/or were first-generation.

Table 1. LEEP Program Participants' Demographics, 2007-2010

Cohorts	Students participated in the program	Sex		Ethnicity		First Generation
		Male	Female	Anglo-Saxon	Other	
2007	41	33	8	20	21	15
2008	28	20	8	14	14	10
2009	26	16	10	17	9	0
2010	22	14	8	8	14	12

Instruments

In 2008, 2009 and 2010, program participants took a computer-based, MPE. The exam was developed through efforts of an NSF-funded grant aimed at improving students' mathematical background as a means of retaining them in STEM majors.

Each item was randomly selected from a pool of problems as students responded to each exercise. In standardized tests, each item has a unique level of difficulty and a discrimination power that was tested and pre-assigned. All items in a standardized, computer-based test assessed one student-learning outcome and the overall difficulty of the test remained the same for each respondent. The MPE carefully evaluated students' performances in a domain using a pre-designed and pre-tested exercise. The 2009 and 2010 participants took the MPE before and after the program. The 2008 participants took the test before the program only. The pre-test and post-test scores were comparable with one another and every test included 33 problems valued at 1per exercise.

Students took a physics achievement test before and after the program that was not computer-based or standardized. The pre- and the post-assessment exams covered the same material, but problems in the post-assessment test were generally more advanced. The maximum score on the test was 100.

Study Design

The independent variables in the present study are the treatment group (bridge program participants), years (2007, 2008, 2009, and 2010), sex (male versus female), ethnicity (Anglo-Saxon versus Other), and being first-generation versus not being first-generation college students. The dependent variables are students' pre- and post-exam scores.

Multiple analyses of variances (MANOVA) across the groups were run. In the findings section we report the significant differences.

Findings

Data for pre- and post-exam scores were collected for each cohort of LEEP participants except 2007. The mathematics pre-test was solely utilized for the 2008 cohort as an admittance mechanism into LEEP. Then in 2009 and 2010 the pre- and post-tests were utilized.

Table 2. LEEP Program Participants' Mathematics Pre- and Post-exams, 2008-2010

Cohort	Number Tested	Pre-test		Post-test	
		Mean	SD	Mean	SD
2008	28	17.29	4.82	-	-
2009	26	18.38	5.57	22.19	6.21
2010	22	21.91	4.51	27.41	5.57

When the math pre- and post-test results in 2010 and 2009 were compared, significant improvements in 2010 were found [$F(1, 46) = 43.13$, $p < 0.0$] in both post-test results.

The 2010 participants (n=22) completed a pre-physics test (M=18.18, SD= 26.23) in the beginning of the summer bridge program and a post-physics test (M=86.27, SD=14.08) after the conclusion of the program. This indicates that the 2010 participants significantly enhanced their physics content understanding at the conclusion of the summer bridge program activities.

Discussion and Conclusions

LEEP is a summer bridge program with a focus to enhance the academic success of first-year engineering students. Similar to other bridge programs across the nation, LEEP attempts to attract students from underrepresented populations who are at a higher risk of not succeeding in engineering. After reviewing the findings, LEEP was successful in attracting a considerable percentage (50% or better of all cohorts) of URM students. LEEP also improved participants' understanding in the subjects of mathematics and physics. The participants exhibited a better understanding of mathematics and physics that will have a positive impact on their academic success during their first year in engineering. In addition, assigning mathematics homework prior to the participants' arrival on campus and making their final acceptance contingent upon completion of assigned homework, provided a mechanism to help in eliminating students who otherwise may not have taken LEEP seriously or be willing to work hard in 2009 and 2010. After comparing the 2009 and 2010 results, doubling the amount of physics classes and adding labs significantly improved student performance on the post-physics tests.

The average SATM scores for the 2009 and 2010 cohorts were 571.3 and 625.9, respectively. With higher SATM math scores, there is a need to further challenge exemplary students in the program. Therefore for the 2011 cohort, plans are being made to offer a research experience to five students who enter with a SATM score above 650. The COE expects to continue monitoring LEEP students and further measure the effectiveness of the program by evaluating URM participant performance, engagement and graduation rates to a systematically (similar high school backgrounds, geographical location of hometowns and/or family makeup) selected cohort of URM non-participants.

Bibliography

1. Atman, C. J., Sheppard, S. D., Turns, J., Adams, R. S., Fleming, L. N., Stevens, R., . . . Lund, D. (2010). *Enabling engineering student success: The final report for the Center for the Advancement of Engineering Education*. San Rafel, CA: Morgan & Claypool.
2. Borrego, M., Froyd, J., & Hall, T. S. (2010). Diffusion of engineering education innovations: A survey of awareness and adoption rates in U.S. engineering departments. *Journal of Engineering Education, 99*(3), 185-207.
3. Landis, Raymond B. (2007). *Studying Engineering: A Road Map to a Rewarding Career*. Los Angeles, CA: Discovery Press.
4. Collins, P. G., Dennin, M., Kaplinghat, M., & Barwick, S. (2010). A Preparatory Freshman Course for Introductory Physics, https://eee.uci.edu/10f/47000/
5. Fowler, D., Maxwell, D., & Froyd, J. (2003). *Learning strategy growth not what expected after two years through engineering curriculum*. Paper presented at the ASEE Annual Conference & Exposition. http://soa.asee.org/paper/conference/paper-view.cfm?id=19039
6. Kezar, A. (2000). Summer bridge programs: Supporting all students. *ERIC Clearinghouse on Higher Education, ED442421*. Retrieved from http://eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED442421
7. Leuwerke, W. C., Robbins, S., Sawyer, R., & Hovland, M. (2004). Predicting engineering major status from mathematics achievement and interest congruence. *Journal of Career Assessment, 12*(2), 135-149.
8. Matanin, B., Waller, T., Kampe, J., Brozina, C., & Watford, B. (2007). *A step in the right direction: Student transition to engineering program.* Paper presented at the 114th Annual ASEE Conference and Exposition, 2007, June 24, 2007 - June 27, 2007, Honolulu, HI, United states.
9. Nave, F., Frizell, S., Obiomon, P., Cui, S., & Perkins, J. (2006). *Prairie View A&M University: Assessing the impact of the STEM-enrichment program on women of color.* Paper presented at the 2006 WEPAN Conference, Pittsburgh, PA.
10. Ohland, M. W., Sheppard, S. D., Lichtenstein, G., Eris, O., Chachara, D., & Layton, R. A. (2008). Persistence, engagement, and migration in engineering programs. *Journal of Engineering Education, 97*(3), 259-278.
11. Challenge Program at Georgia Tech, (Retrieved on October 6, 2010 at http://www.omed.gatech.edu/challenge/).
12. Retention through Remediation: Enhancing Calculus I Success, DUE-0856767, http://nsf.gov/awardsearch/showAward.do?AwardNumber=0856767
13. Texas A&M University, Math Placement Test (Retrieved on January 12, 2011 at https://mathassessment.tamu.edu/precal-cas/).
14. Texas A&M University, New Student Conferences, Math Assessment Requirements and Exemptions (Retrieved on January 12, 2011 at http://newaggie.tamu.edu/es/nsc/testing/math).
15. Texas A&M University, Department of Mathematics, College Algebra/Pre-calculus Tutorial (Retrieved on January 12, 2011 at http://webalg.math.tamu.edu/mindex.htm)