Students at Risk

Walter W. Buchanan

Department of Engineering Technology and Industrial Distribution
Texas A&M University

Introduction

This is a summary of innovative approaches that are being used at several universities around the region to help with student retention and aiding them to be successful in the areas of engineering technology and engineering. Innovative improvements to engineering technology laboratory education to engage, retain, and challenge students of the 21st century are taking place in the Department of Engineering Technology at the University of Houston. Also at the University of Houston studies are being conducted to see who graduates and what might be done to increase the graduation rate. At New Mexico State University the use of physical models to engage student interest is being done. And at Prairie View A&M University strategies for facilitating and improving the retention of students at-risk is being done.

Innovative Improvements to Engineering Technology Laboratory Education to Engage, Retain and Challenge Students of the 21st Century

A departmental sponsored project, CLABS (reads as C-LABS), in the Computer Engineering Technology program at the University of Houston is presented. The initial efforts are presented during start of the project in summer 2004. Also presented are the results of formative assessment of the engineering technology laboratories: a national survey to learn more about what other schools are doing in their laboratories, the development and later analysis of different survey instruments for the full-time and part-time faculty, board of industrial advisors, teaching assistants, students, alumni and simulation software vendors. The initial tasks also included visits to the local junior colleges and community colleges where the program receives majority of its transfer students and meeting and interviewing their faculty. For better dissemination of the experiences, a CLABS web site has been developed. The major thrust behind the philosophy of the CLABS project is determined by the help of the extensive research through surveying and interaction with other colleges: to move away from the cookbook style laboratory manuals. The purpose is to achieve fun, creative, challenging and more importantly, applications-oriented laboratories that lead the students to a project as a final product of their learning experience. Survey results, administrative experiences and challenges in deployment are discussed. It will attempt to draw some meaningful conclusions so that it can pave the way for future laboratory development in similar programs. [1]

The most desired educational outcome of an engineering technology department is the creation of skillful technologists who are able to approach the design and application of both hardware and software with aptitude and creativity. Recent studies show that there is a skills gap between traditional training and the skills actually needed in today's job markets: cognitive flexibility, creativity, knowledge transfer, and adaptability. Therefore, being able to solve new problems based on the knowledge acquired has become a desired outcome of higher-education institutes. The study of science, technology, engineering, and mathematics (STEM fields) is a means to introduce these skills required in today's society. However, STEM will reach this goal only when the education is engaging, interactive and delivers a set of leadership, teamwork, problem solving, analytical thinking, and communication skills. In order to close this educational gap, the long-term goal is to create a progressively more engaging laboratory experience with problem solving emphasis and various skill and knowledge acquisition. At the University of Houston's College of Technology (COT), the Computer Engineering Technology (CETE) Program is seeking to teach students to acquire excellence in laboratory skills by revamping the instructional materials in all core laboratories. The objectives are: (i) active and hands-on student engagement to develop excellent problem solving and troubleshooting skills; (ii) provide opportunities for the students to develop teamwork skills; and (iii) encourage lifelong curiosity towards science and technology by establishing a just-in-time learning environment with project-based materials, instruction, and research emphasis. The major findings and recommendations of the CLABS Project, sponsored by the Engineering Technology (ET) Department and the Dean's office of the College of Technology at the University of Houston are highlighted. The rationale, CLABS educational objectives, followed by summary of the surveys, summary of simulation software research, introduction to the web site for CETE laboratories is presented along with a set of recommendations. The CLABS Project team developed a framework for the operation of the CLABS. This framework was presented to the ET faculty in fall 2004. With unanimous approval of the faculties, the project then moved into its implementation phase. [1]

Who Graduates

The distribution of Myers-Briggs Type Indicators, Preferences, and Temperaments for entering and graduating BSME students at the University of Houston have been determined and compared with similar data taken at the University of Tennessee. It is clear from both data sets that graduation rates vary significantly for individuals preferring different psychological types. For example, individuals preferring "thinking" over "feeling" (Myers-Briggs Preferences) are almost twice as likely to graduate as those who prefer "felling" over "thinking." [2]

Introduction to Design, a sophomore design course, scheduled in the third semester of the BSME program is usually the first course taken by mechanical engineering students in their major (other than the freshman computing course and a pass/fail freshman seminar, Introduction to Mechanical Engineering). As such, it symbolically, at least, represents the "start" of our program. Over the past ten years, 60% of the students enrolled in this course eventually graduated with the BSME. The question is addressed of who graduates and who doesn't based on Myers-Briggs Type Indicators (MBTIs) and their associated parameters. Myers-Briggs Type Indicators have been determined in the sophomore design course since 1991 and in the capstone course (The capstone course is taken in the student's last semester and about 98% of these students graduate.) only since the fall of 2002, but trends are already evident. The MBTIs are compared between the two distributions and with equivalent data in the literature. This effort does not represent a true longitudinal study since the individual students are not followed. However, it has been noted in the sophomore class that even with the relatively small number of students (averaging around 50), each semester's MBTI distribution is remarkably similar to the "running average" distribution for the class. This running average currently represents data on more than 1400 students and is assumed to represent the MBTI distribution of the "input". The distribution for the "output" is that determined for the 111 students enrolled in the capstone design course from fall 2002 through spring 2005. [2]

Use of Physical Models to Encage Student Interest

Engineering students frequently express dismay at the large amount of theory with no apparent application they are forced to endure in the early part of their engineering studies. The faculty, on the other hand, complain because the students appear to have no intuition regarding design. The students' critical thinking skills are slow in developing and putting numbers in an equation is often the apparent goal, not understanding how concepts are used to develop solutions to engineering problems. It is suggested here that, having a physical model as the focus of the students studies may engage them and accelerate their grasp of how equations are useful in predicting real world behavior. If effect, useful in developing solutions, not just solving textbook problems. Two examples are presented here. The first is using the catapult as a design problem across the mechanical engineering curriculum. The student is introduced to the simple catapult as a freshman, and then the problem evolves to a complex catapult as the students analytical tools improve. The second example is the use of the fountain in the Civil Engineering Introductory Fluids class to develop an intuitive understanding of fluid principles in the class. [3]

Most students who enter engineering as a program of study do so because they have a desire to build things. What they desire to build may vary, i.e., rockets, motorcycles, bridges, a business, but they all have a desire to handle and create. The academic institution gives them math, physics, statics, dynamics, English, differential equations, but nothing to connect it to that initial passion to create. It is suggested that an engineering program can be designed to include building interesting, engaging, inexpensive physical models that become an active part of the learning process. Ideally this activity would be integrated into the program from freshman to Senior Year. Common complaints at all levels of education are lack of student interest that materials being taught, lack of continuity in the curriculum being taught, and lack of educational worth in homework assignments. These complaints would be minimized if a student were brought into the curriculum with an interesting, yet not overwhelming, problem to consider. After the initial problem statement, the student would then be given the theoretical tools and progressive assignments to solve the problem. The problem would be designed to evolve and develop greater depth with each additional course the student completes. This will also allow the curriculum to address multiple learning styles and address more student needs. The students come with a desire to make things happen and are willing to work to accomplish this. We must reward them with occasionally doing things that are useful (educational) and fun. Felder (1996) notes that information is transmitted in many different forms and a student must learn to retain well from both verbal and visual modes. If a teacher continually presents information to a student in a format that they find uncomfortable, the presentation technique may interfere with the learning process. In terms of teaching styles/learning styles, traditional engineering lectures tend to focus on the introvert, intuitor, thinker, and judger. Those students who do not fit traditional learning pattern tend to leave the engineering programs since they are continually at odds with the learning pattern presented to them. If a student is a hands-on student, we want that student in engineering. Teaching them in a completely hands off mode may have a tendency to reduce retention of some of our most valuable students. [3]

Strategies for Facilitating and Improving the Retention of Students At-Risk

Many of the students who are considered at risk are those who have been historically underserved by public schools. A large number of these students attend Historically Black Colleges and Universities (HBCU). Due to the demands of the workforce, HBCUs must ensure that the students attain a high level of intellectual skill and knowledge to be a participant in the world economy. At risk students have specific and overt needs that are not the normative needs of the general American college student. These students are more likely to have a wide variety of personal circumstances which can interfere with their ability to give full attention to educational matters. Secondly, interpersonal relationships between students and faculty are essential for academic success; faculty and staff are primary sources through which at risk students make judgments about themselves and their potential to be successful, especially in engineering. Studies at Howard University indicated that the best indicator of success is how well the students perform during the first year of college; hence good academic advising is a critical component during the first year. The objectives are to define an at risk student based upon a predictive approach, discuss the importance of reducing the risk of academic failure, identify barriers to academic success in engineering to at risk students, identify current trends and approaches used in colleges and universities and present simple strategies and skills that can be incorporated to improve the chances of academic success in engineering for at risk students. [4]

The definition of an at risk student has changed over time. Originally, at risk students were defined as those whose appearance, language, culture, values, communities, and family structures did not match those of the dominant white culture that schools were designed to serve and support. Currently the predictive and the descriptive approaches are the most commonly used strategies for defining the at risk student population by schools and policy makers. The predictive approach defines at risk students as those who have certain kinds of conditions such as from a low socioeconomic status, living in a single parent household, or being a member of a minority group. While the descriptive approach defines at risk, students as those who are already performing poorly or failing in school. This approach identifies the student as at risk after school-related problems occur. Since an "ounce of prevention is worth a pound of cure," the predictive approach is preferred. Many studies support the predictive approach. A study by Kaufman and Bradley in 1992 indicated that a student's demographic characteristics, gender, race-ethnicity, and socioeconomic status are identified as being associated with an increased probability of school dropout. [4]

References

1. Attarzadeh, F., Gurkan, D., & Benhaddon, D., "Innovative Improvements to Engineering Technology Laboratory Education to Engage, Retain, and Challenge Students of the 21st Century," *Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference,* Southern University and A&M College, Baton Rouge, Louisiana, March 2006.
2. Bannerot, R., "Who Graduates?" *Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference,* Southern University and A&M College, Baton Rouge, Louisiana, March 2006.
3. Hanson, A., Hanson, T, Bawazir, S., & Jacquez, R., "Use of Physical Models to Encage Student Interest," *Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference,* Southern University and A&M College, Baton Rouge, Louisiana, March 2006.
4. Obiomon, P., Nave, F.M., & Frizell, S.S., "Strategies for Facilitating and Improving the Retention of Students At-Risk," *Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference,* Southern University and A&M College, Baton Rouge, Louisiana, March 2006.

WALTER W. BUCHANAN
Dr. Buchanan is J. R. Thompson Chair Professor and Head of the Department of Engineering Technology and Industrial Distribution at Texas A&M University. He received his BSE and MSE from Purdue University, and his Ph.D. and J.D. from Indiana University. Walt is a P.E. in six states, and is Chair-Elect of the Engineering Technology Council of ASEE. He has written over 100 papers, and is a Member of the Executive Committee of TAC of ABET.