

“Design Your Process of Becoming a World-Class Engineering Student”—A Powerful Project for Enhancing Student Success

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Abstract - A new innovative approach has been developed to enhance engineering student success by strengthening students commitment to completing their degree in engineering and changing their attitudes and behaviors to those appropriate to success in math/science/engineering coursework. The approach involves implementation of a project titled "Design Your Process of Becoming a World-class Engineering Student" in which students look at where they are and where they would need to be in a number of important areas related to their learning process and academic success and develop a plan for moving from where they are to where they need to be. The approach, including the project, can be implemented in any first-year engineering course without major changes to the overall curriculum. Currently, over 30 institutions are implementing the project. Implementation and thorough assessment at two four-year institutions has shown an increase in cumulative first-year GPA of half a point and retention increase by 10%. Because this approach can be implemented virtually anywhere with minimal cost and change of curriculum, it is the low hanging fruit to improve engineering student success, retention rates, and time to graduation. Participants of the workshop will have the opportunity to learn about the approach through interactive exercises and will receive extensive support material. The main focus of the workshop will be on the implementation of the project at the participants' institutions.

Index Terms - design project, first year students, self-regulation, student development, student success.

INTRODUCTION

There is a current concern about the growing need for more engineers in the U.S., and therefore first-year engineering student retention needs to be improved. A national study conducted by Michelle J. Johnson and Sheri D. Sheppard [1] shows that over 30% of first-year engineering students do not finish with a degree. Even more concerning is that only 8% of all students enrolling in a four year college chose an engineering program. This demonstrates the importance to focus on first-year engineering education and enhancing the students' commitment to graduate with an engineering degree.

A recent study on why students stay in engineering has shown that increasing the first-year student's academic confidence helps the student adjust to the rigorous engineering curriculum [2]. In another study, students ranked "drive and motivation" as one of the top influences to believing they could succeed [3]. Successful minority retention programs have focused on community building, academic success skills, personal development, professional development, and orientation in a first-year introductory engineering course [4]. The 2004 ACT policy report on The Role of Academic and Non-Academic Factors in Improving College Retention identified the following factors as the strongest in predicting college retention or performance: academic-related skills, academic self-confidence, and academic goals [5].

Therefore, having first-year engineering students design their individually tailored learning process as part of a semester long project in the setting of a student success focused introduction to engineering course will have a significant impact on their academic success by improving the students' academic-related skills, confidence and motivation to succeed in engineering.

PROJECT DESCRIPTION

The project "Design your Process for Becoming a World-Class Engineering Student" asked students to design their own individual process to be successful in graduating with an engineering degree.

To help guide students in evaluating themselves they are asked to implement a three step process:

- What is your current status on implementing these topics/objectives
- Where should a "world-class" engineering student want to be on each of these objectives
- What you need to do to move from where you are to where you want to be

By analyzing part a. and b. students are able to answer c. which tells them their process to success for each individual objective/task. The minimum recommended length of the paper is set at ten pages, but students are encouraged to write 12 pages or more, and no maximum page limit is enforced. The workshop will provide solutions

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on how to grade papers, especially for large enrollment courses.

A support website has been developed to help other instructors with the implementation of the project [6]. The website provides class room material, sample student project reports, assessment/research materials and more.

A general handout of "Design your Process for Becoming a World-Class Engineering Student" has been published in Appendix A of "Studying Engineering: A Road Map to a Rewarding Career" [7]. The project challenges students to evaluate themselves against a "world-class" engineering student using the following tasks:

1. Set goal(s) for what you want to achieve through your engineering education (major, time to graduation, GPA, etc.) and beyond
2. Develop a strong commitment to the goal of graduating in engineering by:
 - a) Clarifying what success in engineering study will do to enhance the quality of your life (rewards, benefits, opportunities, payoffs, etc)
 - b) Understanding the essence of engineering (be able to articulate an answer to the question "What is engineering?")
 - c) Being aware of past engineering achievements, current opportunities (academic disciplines, job functions, industry sectors) and future directions.
 - d) Preparing a "road map," a term-by-term plan to guide you to graduation
 - e) Other strategies identified by you.
3. Be prepared to deal with inevitable adversity
4. Do a good job of managing various aspects of your personal life including interactions with family and friends, personal finances, outside work, and commuting.
5. Change your attitudes to those appropriate to success in math/science/engineering coursework. Among those that are candidates for change are:
 - a) Low self-confidence or overconfidence
 - b) Reluctance to seek help
 - c) Resistance to change, grow, develop, improve
 - d) Tendency to procrastinate
 - e) Avoidance behavior (avoid difficult or unpleasant tasks)
 - f) Reluctance to study with other students
 - g) Negative view toward authority figures
 - h) Other negative attitudes identified by you
6. Understand teaching styles and learning styles and how to make the teaching/learning process work for you.
7. Understand and practice the concept of "metacognition" to improve your learning process by observing your learning process, feeding back to yourself what you observed and making changes based on that feedback.
8. Change your behaviors to those appropriate to success in math/science/ engineering coursework to include at least:
 - a) Devoting adequate time to studying
 - b) Adopting the principle that you master the material presented in one class before the next class comes
 - c) Make effective use of your peers through sharing information and group study; build productive relationships for college and beyond
 - d) Make effective use of your professors both inside and outside of the classroom
 - e) Prepare for lectures by reading ahead, attempting a few problems, formulating a few questions
 - f) Other behaviors identified by you
9. Manage your time and tasks effectively
10. Understand the principles of teamwork and leadership and develop skills to be both an effective team member and also an effective team leader
11. Participate in co-curricular activities to good benefit
12. Understand and respect differences in learning styles and personality types and in ethnicity and gender
13. Engage in good health and wellness practices including management of stress
14. Develop a high sense of personal and professional integrity and ethical behavior
15. Become effective at getting what you want and need from the educational system by utilizing campus resources (such as advising, tutoring, job placement services, health center, etc)
16. Add up to three additional objectives that you perceive are important for your success in engineering study

WORKSHOP DESCRIPTION

This workshop is facilitated by an experienced first-year engineering educator and offers a collaborative format for people interested in improving first-year engineering student success. Specific structured discussions and activities include:

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- What is student success?
- Exploration of a student's reflection on how to be successful as a first-year engineering student.
- Implementing the "Design Your Process to Become a World Class Engineering Student"
 - Incorporate the project in existing courses/seminars
 - Collaborative learning strategies to support the objectives of the project
 - Overcoming barriers for implementing the project
 - Available support material for the project
 - Joining the research effort – implement, assess, publish

The collaborative nature of this workshop is aimed to provide participants the opportunity to develop a support network that will extend beyond the workshop and will help with the implementation of the project. Results from the implementation of the project at the University of Alaska Anchorage, Oregon State University [8,9] and California Polytechnic State University will be shared. Besides a comprehensive handout additional material in electronic form, such as homework assignment, in-class presentations and more, will be made available to all workshop participants to ease the process of adaptation.

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