

2006-2457: RETENTION AND RECRUITING ACTIVITIES IN A MECHANICAL ENGINEERING PROGRAM

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Retention and Recruiting Activities in a Mechanical Engineering Program

ABSTRACT

This paper discusses the relevance of a strategy of retention and recruitment within an engineering program in particular the Mechanical Engineering at Alabama A&M University and shows some results from the proposed solution for increasing the retention as well as enhancing recruitment activities within the department. The department of Mechanical Engineering is a relatively new program that started in fall of 1998 with two students. That number increased to 5 in the second year, 10 in the third year, 50 in the fourth year, 100 in the sixth year and 150 in the seventh year. Historical data within the department of Mechanical Engineering indicates that out of the total number enrolled, 30 percent of the students lost to other programs are within the freshmen level standing. That number showed a reduction to 10 percent in the sophomore year, 5 percent in junior standing and nearly zero percent in the senior level. Two dominating factors that affect the student population within the department are the issues of recruitment and retention. This paper addresses some analysis done on the factors affecting the enrollment and recruitment. Retention factors such as class attendance, supplemental teaching tools, early exposure of the potential students to Mechanical engineering topics, advising, and student participation in student competitions and summer internship programs are examined. For the recruitment, factors such as assessment tools for the state of the program, preparation of standard recruiting packages, increasing the incentives such as scholarships, and potential internship with highly recognized companies as well as engaging local high school students are considered.

BACKGROUND

Alabama A&M University (AAMU) is a land-grant historically black university. The University is located at the northeast outreach of Huntsville, Alabama, an important world center of expertise for advanced missile, space, electronic, research and development. AAMU provides a scholarly environment for teaching and research. As a historically black institution, the University seeks to address the special needs of capable students disadvantaged by systems and circumstances which have thwarted their efforts and chances for normal educational opportunities. A continued responsibility for this element of our society is strongly embedded in the mission of the University. The department of Mechanical Engineering is a relatively new program that started in fall of 1998 with two students. That number increased to 5 in the second year, 10 in the third year, 50 in the fourth year, 100 in the sixth year and 150 in the seventh year. Historical data within the department of Mechanical Engineering indicates that out of the total number enrolled, 30 percent of the students lost to other programs are within the freshmen level standing. That number showed a reduction to 10 percent in the sophomore year, 5 percent in junior standing and nearly zeros in the senior level. Two dominating factors that affect the student population within the department are the issues of recruitment and retention. This paper addresses some analysis done on the factors affecting the enrollment and recruitment. Retention factors such as class attendance, supplemental teaching tools, early exposure of the potential students to Mechanical engineering topics, advising, and student participation in student competitions and summer internship programs are examined. For the recruitment, factors such as assessment tools for the state of the program, preparation of standard recruiting packages,

increasing the incentives such as scholarships, and potential internship with highly recognized companies as well as engaging local high school students are considered.

ISSUES AFFECTING RETENTION

In most programs, retention plays a fundamental role on the student population. This issue may become more pronounced in upper level engineering courses, since by then a considerable amount of resources has been spent on training of the students. A number of reasons are attributed to the loss of students from a given engineering program. For example the students might change major to another program, might “drop off” the school altogether, might find jobs and abandon their educational objectives or perhaps discontinue for a short period of time and start again later. Although it is nearly impossible to eliminate loss of students from the program, it is possible to minimize this loss by implementing several tactics. Some of the factors affecting the retention of the students within the mechanical engineering program at AAMU are considered below.

Class Attendance and participation

One of the major factors that lead to the students dropping the class in a particular semester is the issue of attendance. Often students miss too many classes (due to a variety of reasons). The missed classes lead to lower performance in the class which consequently ends up with the student having to drop the class. On the other hand it is not often feasible for the instructor to take class attendance, especially if the enrollment is high in a given class; even so, if the attendance is taken it is not easy to track down on the attendance history of the student. One method proposed here will address both the issues of increase attendance and will eliminate the need for the instructor to take the attendance while saving a valuable class time. The method proposed here is to prepare an attendance sheet with the format shown in Table 1.

Table 1. Sample sign up sheet used in the classes

Please sign your name in the corresponding column				
	Name	Monday (1/16)	Wednesday(1/18)	Friday (1/20)
1	Joe Brown			
	...			
	...			
20	Jack Smith			

Then pass on the sheet in the class and have the students sign their name in the corresponding row. The advantage of this format is that it is easy to trace the attendance history of a student and hence immediately be able to contact the student and consult him/her about his/her performance.

Supplemental teaching tools

In many cases when the students have difficulty understanding the concept, it is necessary to see the instructor for further clarification of the topic. Often the instructor's office hours may not match the students schedule and in many cases the students might simply dismiss a meeting with the instructor to discuss the topic. One method of addressing this issue is to utilize Power Point presentation to develop teaching aids that is specific to a given topic for each course. The power point presentation will utilize the multimedia and especial effects such as narration, etc. to explain the topic. Therefore it is proposed to develop a library of topics for each course, that would explain a particular topic clearly to students without the physical presence of the instructor. To accomplish this goal it is proposed to develop proposals for funding agencies for each faculty member to be engaged in developing such teaching aids. A sample of a supplemental teaching tool used in the class for ME 231- Mechanics of Materials is shown in Appendix A. Based on the feedback obtained from the students utilizing the material, 8 out of ten surveyed, described the teaching tool extremely useful.

Early Exposure of the potential students to Mechanical Engineering Topics

This is an important issue in which the idea is to maintain contact with the Mechanical Engineering students within the first two years of their college. Traditionally, the curriculum in the department was set up in such a way that once the prospective Mechanical Engineering Majors took ME 101-Introduction to Mechanical Engineering, they lost contact with the ME faculty until the second semester sophomore or first semester junior. Two additional changes were made to the curriculum which caused the interaction within ME faculty and the ME majors to increase. The changes are addition of ME 103-Introduction to CAD and ME 104-Engineering Analysis and Computing to the curriculum. Although there is no formal study in support of this claim, but these changes appear to be instrumental in increase in retention of the ME students. Since there are no pre-requisites for any of the ME 101, ME 103 and ME 104 courses, the students, in theory, maybe able to take all there courses in one semester. However, if these courses are ordered in such a manner so that each is taken in three consecutive semesters as opposed to all in one semester, it may be possible that the retention figures will improve even further. The reason is that the students will have contact with a Mechanical Engineering faculty and therefore their progress in other non-major but vital courses (such as Calculus an Physics courses) maybe monitored and managed.

Advising

One of the central issues to the retention is student advising. Traditionally the prospective mechanical engineering students were advised at the university college. In most cases, the

Slide 1

Positive Convention for Analysis of Beams

If you analyze the members from left to right, for shear, downward direction is positive and for moment, counter clockwise (ccw) direction is taken as positive

If you analyze the members from right to left, for shear upward direction is positive and for moment, clockwise (cw) direction is taken as positive

Slide 5

Driving Shear Equations

Consider the first section: $0 \leq x \leq \frac{L}{2}$

$$\sum F_y = 0$$

$$V - \frac{F}{2} = 0 \quad \text{or} \quad \boxed{V = \frac{F}{2}}$$

Next consider the second section $0 \leq x \leq L$

$$\sum F_y = 0$$

$$V + F - \frac{F}{2} = 0 \quad \boxed{V = -\frac{F}{2}}$$

Slide 2

Example 1

Consider the beam shown in the following figure.

The beam is supported at ends A and B and a force of Magnitude F is applied at the center of the beam.

Our objective is to draw the shear and bending moment diagram for this beam.

Slide 6

Plotting the Shear Diagram for the Beam

Slide 3

Calculating Reaction Forces

The first step is to calculate the reaction forces at A and B. From Symmetry it is evident that both R_A and R_B are equal To $F/2$. We can also calculate the reaction forces by:

$$\sum M_i = 0 \quad \sum F_x = 0$$

$$F \frac{L}{2} - R_B L = 0 \quad R_A + R_B = F$$

$$R_B = \frac{F}{2} \quad R_A = F - R_B = F - \frac{F}{2} = \frac{F}{2}$$

Slide 7

Moment Equation for $0 \leq x \leq \frac{L}{2}$

Valid for: $0 \leq x \leq \frac{L}{2}$

$$\sum M = 0$$

$$M - \frac{F}{2}x = 0$$

We draw the free body diagram (FBD) for the beam: The external Forces and Moments are ... $F/2$ at the support and ...

The moment M at the point where the beam is cut. We denote the distance from origin to the point of cut as x. $\boxed{M = \frac{F}{2}x}$

We are now ready to write the moment equation:

Slide 4

Examining Shear Loads

$0 \leq x \leq \frac{L}{2}$

$0 \leq x \leq L$

Slide 8

Plotting the Moment Diagram for the Beam

$$M(Max) = \frac{F L}{2}$$

$$M = \frac{F}{2}x$$

$$M = \frac{F}{2}x - F\left(x - \frac{L}{2}\right)$$

Figure 1. Sample of PowerPoint presentation used as a supplemental teaching aid. The example shown here is about analysis of beams which includes narration, and flybys (not shown here).

Students were required to take a set of specific course which at times may not have been compatible with the curriculum of the ME department. Through the request of the ME department, the students who had declared ME as their major were referred to the ME office and from there they were assigned an advisor within the department of Mechanical Engineering. The idea for this change was for the department to have a closer contact with the students and to be able to monitor their progress more closely. Consequently in case the students had problems with a particular course, they could go to a specific faculty who was familiar with their academic progress and could offer meaningful advice to them. The advisors are provided with forms that keeps track of the progress of each student. The students are reported to their corresponding advisor during the registration period and report their performance to the advisor and as well as decide on the courses that they should take in the following semester. One such departmental form is shown in Figure 2.

Student Competitions.

There are a number of national competitions that are sponsored with various government and non-government organizations and are tailored mostly towards the application and synthesis of Mechanical Engineering concepts to various engineering projects. One such program is the “Great Moonbuggy Race” sponsored by NASA Marshall Space Flight Center. It is believed that participation of the students in these completions will increase the exposure of the students to other fellow mechanical engineering students and hence will motivate them in pursuing their careers. On the other hand, participation in the competitions will give the students a hands on experience in which they can appreciate the classroom knowledge and it’s application to real-world engineering problems [1]. Indeed it is observed that the participating students have enhanced their performance in various courses. It is therefore imperative to gain funding for such competitions on a permanent basis. Faculty within the department is encouraged to write proposals to secure funding in support of such competitions.

Participation in Summer Internship Programs

Summer internship programs have similar affect as in Student Competitions. Students participating in summer internship are able to enhance their class performance by applying their class room knowledge to real world engineering problems that are of interest in the government and industries interest. Past few years several of the ME students have been able to participate in the programs sponsored by Oak Ridge National Laboratory, NASA Marshall Space Flight Center, and Rolls Royce Corporation to name a few. One additional measure may be implemented to further harness the benefits of the summer internship program. That is if an additional seminar or class is included in the ME curriculum so that the students who have participated in the program may present their research work (provided that their research is not subjected to export or copy rights of the organization) and expose other students to the real world engineering problems. It is believed that such class would prove to be extremely valuable for retention, especially retention at the Freshmen and Sophomore level.



MECHANICAL ENGINEERING PRE-REQUISITE GUIDE

(MANUFACTURING OPTION)

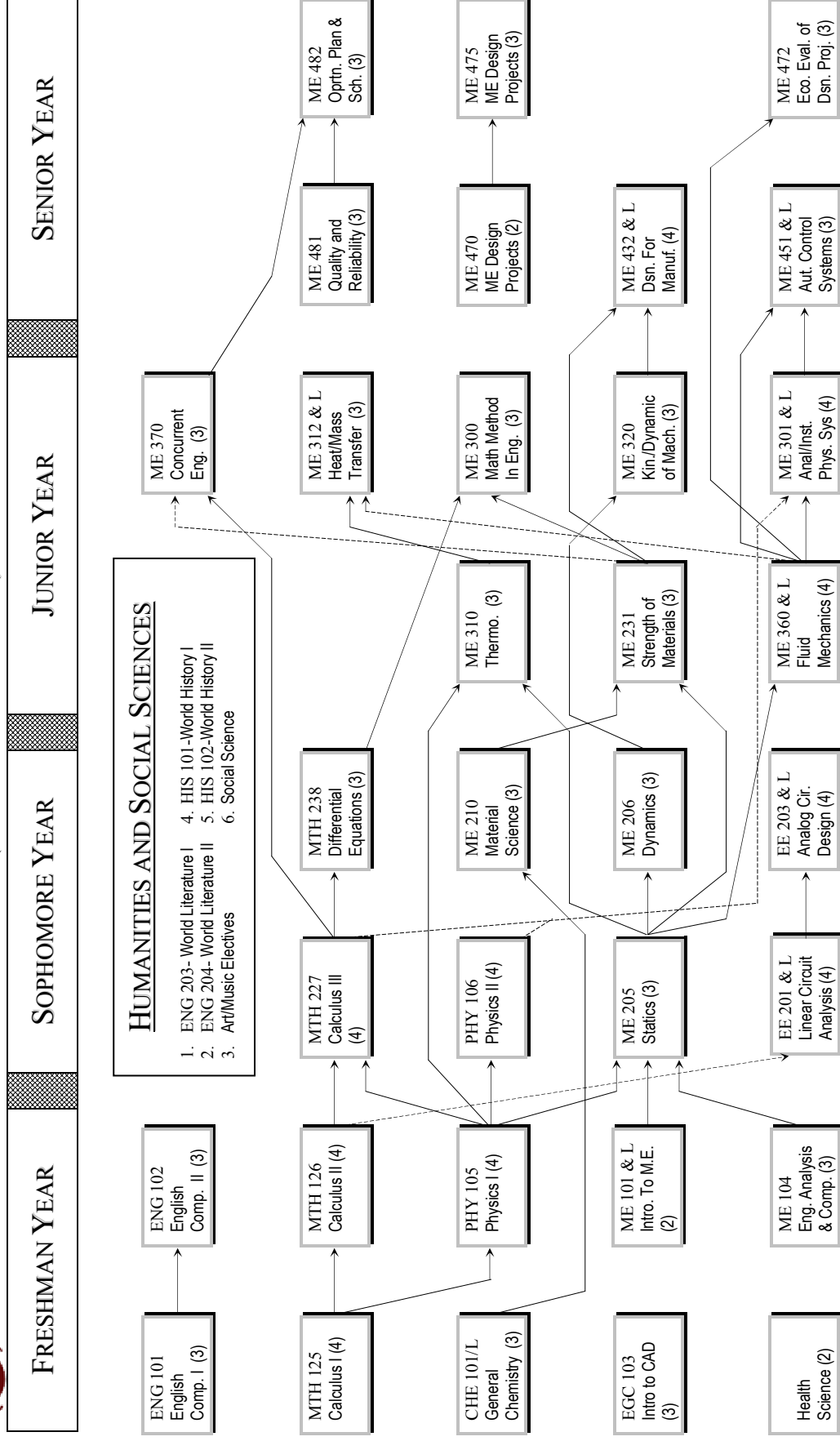


Figure 2. Typical form used by faculty members in the advising process.



Figure 3- Participation in national competitions such as the “Great Moon Buggy Race” sponsored by NASA Marshall Space Flight Center held in Huntsville, AL helps the students to better understand some challenges involved in the design of an engineering system as well as students a hands on experience in which they can appreciate the classroom knowledge and it’s application to real-world engineering problems.

Participation in financially supported projects

Financially supported research projects attract prospective students in the programs and, thus, increases the number of eventual potential graduates that include under-represented minorities. These potential graduates would be useful hands in the interdisciplinary fields involving science, mathematics, and or engineering. The existence of financial support to the under-represented minorities is an attractive feature to enhance retention rate at the sophomore level for concentrating studies in engineering disciplines. Citing evidence of project oriented financial support for the students is an attractive technique for motivation. This motivation assures students in multi task projects and thereby builds strength. This strength reflects students’ learning and directs them towards completing their educational goals in engineering. In a true sense these potential graduates may involve in as many multidisciplinary tasks as they may encounter in the working arena.

RECRUITING STRATEGY

Entering new freshmen as well as transfer students constitute big weight of the composition of the student body within a given program. It is therefore important to formulate a strategy to attract those students into the program. One of the most effective recruiting techniques might be attributed to the “word of mouth.” The effect of this recruiting strategy may not immediately be felt by the department. This aspect may have as much adverse affect on recruiting as it may have positive effect. Factors that may influence this are quality of education, laboratory facilities, participation in teacher’s attitude and attention that may be given to students, and student to teacher ratio. Factors outside of the boundary of the department involve athletic program of the

school, geographical location of the city, etc. Although the department faculty and staff may have little or no control over the outside factors, the affairs of the school within the department could be controlled and hence the quantity as well as the quality of the students entering the program may improve drastically.

Direct approach

In this approach the faculty and the staff are directly engage with the potential students entering the program. Some of the steps taken that will enhance the recruiting activities within the program are listed below.

Make assessment of the state of the enrollment to the program

Statistical data that will provide information on the following items should be acquired:

- (a) number of students currently enrolled into the program
- (b) number of students who are actively taking courses
- (c) number of students who are transferring into and out of the program,
- (d) number who have taken courses in ME but have either dropped out of program or have changed major,
- (e) and number who have declared ME as major, but have not participated in the courses yet is to be obtained.

With this data, a clear picture of the enrollment is obtained.

Obtain statistics from the freshmen class as in how they heard about the ME program at AAMU.

Tracking useful data for the assessment outcomes of recruiting and retention activities is a critical element of overall assessment of program recruitment and retention activities. Without more sophisticated data collection to support survey results, effective evaluation based on outcomes is not possible [2]. The statistical data collected is considered to be extremely valuable, so that the recruiting effort could be concentrated into the area in which the feedback is received from the freshman class or transfer students.

Preparing a standard recruiting package

The package should include a CD describing the activities in the program, program description, information about the city, job opportunities for the mechanical engineers, etc. This package should be in “ready to be shipped” statues for the prospective students.

Participation in recruiting activities that takes place via the school

AAMU office of admissions takes part in several recruiting trips every year. The schedule for such trips is provided by the office of admissions. If the faculty time allows, it is requested that each faculty to participate in such trips. In addition to that, it is requested that high school

counselors from each department to be contacted and be given a package that can be presented to the senior students at a particular school. In addition to that above trips, the AAMU sponsors a high school day each year. In that event students from the high schools from the local states and cities attend the school and learn more about each of the academic programs as well as other activities within the school. The mechanical engineering department has active participation in this activity each year and in that event the department has been able to reach a number of potential students.

Increasing the Incentives such as scholarships

Currently the school offers several GPA-dependent scholarship that are available to the students. Eligibility for such scholarships requires full-time standing. In addition to that the department also offers additional scholarships that may attract the students to the program. It is anticipated that the increase in the number of such scholarships, not only will enhance the retention but also will increase the recruiting.

Preparing summer outreach programs and engaging local high school students.

Currently many schools are engaged in this program to attract local high school students into the engineering program. Some of these programs are tailored to increase diversity within a particular engineering program [3,4]. There is already a summer internship program (Michael Anderson Summer Outreach Program) available with the school of engineering in which students from local high schools are encouraged to apply. ME departments participation in such programs could improve the recruitment to the program. Also participation and engaging the local high schools and mentoring them in their national competition will increase the contact between the ME professors and the students and it is anticipated that will enhance the recruiting. Figure 4 depicts some of the activities that takes place in the Summer internship programs within the school of engineering. Some of those activities include participation in Lego robotics, bridge competition, reverse engineering, communication, web design, etc.

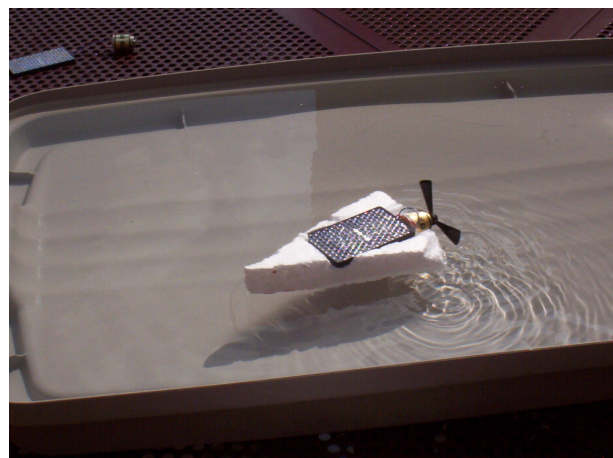


Figure 4. Two of the activities that takes place in the summer internship program at Alabama A&M university. Here High school students participating in the program are engaged in the Lego robotic competition and the boat racing competition.

CONCLUSIONS

A number of issues that affect the enrollment of mechanical engineering program at Alabama A&M university has been addressed here. Specifically two issues are addressed (1) the issue of retention; i.e., what measures should be taken to keep the qualified students in the program and (2) issue of recruitment; i.e., what measure to take to attract new students into the program. In this paper several issues that were relevant to the retention and recruiting within the mechanical engineering program were examined and a strategy for implementing these ideas was presented. For retention, factors such as class attendance and participation, supplemental teaching tools, early exposure of the potential students to Mechanical engineering topics, advising, and student participation in national competitions and summer internship programs were examined. Tools, using PowerPoint presentation, that could be used in conjunction with the teaching lessons were presented. Data collected from students up to this point appears promising. Nearly 8 out of ten students have indicated that the supplemental teaching tool provided to them at the lecture has in fact helped them tremendously in understanding of the topic presented to them. It is anticipated that evolution of such teaching tools will indeed enhance the retention within the ME program. Other factors such as student participation in national competitions have shown promising results as well. Students from different levels have participated in the “Great Moon Buggy Race” and all the students participating in that competition have been able to successfully complete their degree to date. Students participating in the competition have indicated that this “hands on” project and their experience with the design of the system has given them a new perspective in the field of mechanical engineering. For the recruitment, factors such as assessment tools for the state of the program, preparation of standard recruiting packages, increasing the incentives such as scholarships, and potential internship with highly recognized companies as well as engaging local high school students were considered. Students participating in the “Michael Anderson Summer Internship Program” have given positive feedback towards the program and have indicated that they have a better understanding of the engineering environment. Some of the students participating in the internship program have indicated further interest in pursuing their engineering degree at Alabama A&M University.

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