Helping Undecided Students Select a Major in Engineering

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Abstract

Undecided majors are often unclear about their interests and are overwhelmed with the numerous choices available to them. Even when engineering is selected, it is best both in terms of efficiency and academic success to select a major as soon as possible—at least in engineering colleges where freshmen and sophomores take courses within the major.

While the selection of a major is not an exact science, we have discovered that students and parents are pleased to have simple guidelines in this process. This paper reports a simple process to select a major within engineering. The process was used with incoming students in the College of Engineering at Texas Tech University in Fall 2001. Results indicate that about 10 percent of our incoming freshmen may have interest that better match non-engineering majors. Another 16 percent appear to be a match for engineering but may be in the wrong major within engineering. At present we are observing the actions of these students compared to students who appear to be in the right major. No intervention is planned.

This paper describes the process and the results observed to date. We have had numerous letters, cards, emails from parents and students expressing their appreciation. We have even had one student turn down a scholarship at another major university to attend Texas Tech University "because we cared more about students" than the other university.

Introduction

A common fact of the first year of college is that many students change their major. Some students change majors several times before they finally graduate. Some fail to graduate. Engineering colleges are not immune to this problem—instead they often have the greatest loss of students.

Uncertainty of major can cause several problems. Students not committed to a major may give up on courses that are challenging. Disinterest in a major may lead to poor study habits, little interest in learning, and reduced learning efficiency. Delays in discovery of an appropriate major often cause courses to be taken that do not count toward the final major. Thus, costs increase for the student and the taxpayer for public institutions. Students who discover and pursue their major early can select electives in high school and arrive at college better prepared than students who delay in their selection. First generation students are often more uncertain of major, which leads to additional risk of failure before graduation.

Therefore, there is a need for an inexpensive way to help students of all ages to analyze and discover an appropriate major. This process needs to be easy to use and relatively quick to complete to accommodate walk-in undecided students and undecided students at orientation.

Objective

Engineering is a highly rewarding profession. Engineering is also a major plagued with low retention within major. Students tend to change majors away from engineering and within engineering especially during the first year in college.

A relatively high number of students interested in engineering either as perspective students or even during orientation at college are undecided about what major within engineering is best or at least appropriate for them. The objective of this paper is to report a process developed in the College of Engineering at Texas Tech University that helps undecided students discover an appropriate major within engineering. This process helps students and also helps make the processing of students more efficient during the orientation process.

Development

The College of Engineering at Texas Tech University has over a decade of history in the development of tools to help students improve their academic performance. One of the more recent developments now available on the web, http://edtool.coe.ttu.edu.eddoc, is **ED DOCTOR**. **ED DOCTOR** currently provides career mapping and learning styles assessment. Each of these assessments takes 5 to 10 minutes to complete and provide results immediately. Both processes were developed in the College of Engineering and initially used with paper versions. After initial evaluation from use in the College of Engineering and with encouragement from Dr. William Carter, licensed professional psychologist and Director of Texas Tech University Testing and Counseling Center, the processes were redeveloped to operate on the web.

During the summer of 2000, it was observed that most students attempting to return from college after second suspension, which require dean's approval at Texas Tech University, had a common pattern on the learning styles assessment. The pattern was a low preference for learning with either hearing or reading and a high preference for learning with either somatic (hands-on learning) or visual learning. At one time during the summer, 12 students had been analyzed and

10 out of the 12 (83 %) had this extreme or imbalance in learning styles. Of the two students with a more normal pattern, one had a discharge from a military service for a personality disorder. Follow up evaluation at the Testing and Counseling Center for the other student revealed a limitation to visualize two- and three-dimensional information. The other 10 students were also analyzed with follow up testing and were thought to have a learning disability. Thus, it was concluded that certain patterns on the learning spectrum could be associated with learning disabilities.

It should be noted that Texas Tech University provides accommodations for students with learning disabilities and has produced several successful graduates who have learned how to deal with their learning disability. One of the processes that has been the key for this success is implosion. Dr. William Carter, mentioned earlier, has been a leader in developing and implementing this process. This process is described by Gregory et al.[1] Students using implosion take multiple sections of the same class with different instructors, concentrate class selection in one area, such as math for engineering and science majors, and take one or two courses in physical education to reduce the probability of depression[2] and to increase oxygen levels in the body. While the College of Engineering does not seek out students with learning disabilities, the college tries to be proactive to accommodate students who need and seek help.

It was also observed early in the use of the learning styles assessment tool that on the average engineering students had a common pattern. It has now been learned that a variety of majors can be mathematically described by their average learning style or spectrum.[3] When a student matches both the career map location and the learning spectrum for engineers, there exists a high probability that the student has an adequate natural interest in math, science, and things to consider engineering as a major.

Neither career map nor learning style spectrum can be used to select majors within engineering, computer science, or engineering technology. There is a difference between business computer majors and computer science majors in engineering, however. Perspective students who are undecided about engineering typically visit with the Associate Dean for Undergraduate Studies. During orientation, undecided engineering students also have an opportunity to visit with the faculty person who directs the orientation process. As the College of Engineering has grown in numbers, the time demand for this service has also grown.

Hence a survey form (given in the Appendix) was developed in an attempt to capture some of the information collected with the verbal interaction. A word or short phrase was selected to associate with a given major in the College of Engineering. Because we have 10 majors, we needed 10 words or phrases. To increase reliability, the process was repeated three times. Three replications were selected as a compromise between reliability and ease and quickness to complete the process.

Initially, the process was evaluated by having a few of the Peer Mentors in our **BRIDGE** program use the form. They were asked to order the 30 items from most preferred (1) to least preferred (30), using all numbers from 1 to 30. The process was reasonably successful in matching their majors. At least one of the top three majors matched their current major. Next, an advisor or chairperson from each major was asked to look at the sheet and to offer modification to the words or phrases. In computer science, for example, the original phrase of number science was replaced with data manipulation.

The next phase of testing was to use the sheet with perspective students, students changing majors away from engineering, and students struggling academically in engineering. The oral interview process was also continued with these students. Generally, the form matched the information obtained by the interview. Some of the students indicated that they wished that they had been provided the information earlier in their college career. Perspective students and parents were very pleased with the process. While we do not think the results should be used as a concrete indicator of a major, we observed that the process causes students to think and visit with their parents and ultimately caused them to work from a smaller list of options. We have received several email and written notes of thanks as well as numerous verbal thanks for our process and interest in the welfare of students.

Office staff who deal with perspective students also became quick adaptors of the tool and were able to provide the same service in absence of the associate dean. There use of the process is one of the real measures of success.

Based on the positive feedback, we decided to add the survey form to the orientation process. All students were asked to complete the form during summer 2001 orientation. The information was used immediately with undecided students to help them narrow the number of engineering majors to evaluate. In many cases, the student was comfortable with the first choice outcome from the process and chose to declare that choice as their major. In other cases, the choices were narrowed to two and the student visited each department. Some selected a major at this point. Some continued to be undeclared but selected courses that worked for both choices. Very few remained totally undecided. The number of undecided majors in engineering has dropped. This has been a good thing in terms of time demand for advising in the Dean's Office.

Data sheets from all students were collected and returned to the Dean's Office. Data were entered into an Excel sheet and saved for later use if a student visited the Dean's Office with questions about their major or if they were experiencing academic difficulty. Analysis of this data set is given in the results section.

Results

Over 400 freshmen students completed the survey form. Of these students, 9.9 percent mapped away from engineering. Sixteen percent of the freshmen also appeared to be in the wrong major within engineering. They mapped in the general area for engineering but appear to have selected a major within engineering that does not match their natural interest.

After completion of the fall semester, grades were added to the data set. While it is too early to obtain conclusive results, we will present results after the first semester for the 227 students analyzed to date. For now, we assume that the 227 students analyzed to date are a reprehensive sample of the larger group of 400 students.

We divided these 227 students into groups depending on their GPA after the fall semester. We counted the number of students who have switched to another major at Texas Tech University. These results are shown in Figure 1. The percentage of students who switched to another major away from engineering increased approximately linearly as the GPA dropped. The one exception was the 2.0 – 2.49 range. There were no students who switched in the 0.0 to 1.49 ranges. All of these groups were very small. The group in the 1.5 – 1.99 range probably were poorly prepared for the math and science courses required for engineering. We assume these losses are associated with academic preparation from high school and not just interest in major. Academic performance certainly has to change for these students to stay in engineering until graduation.

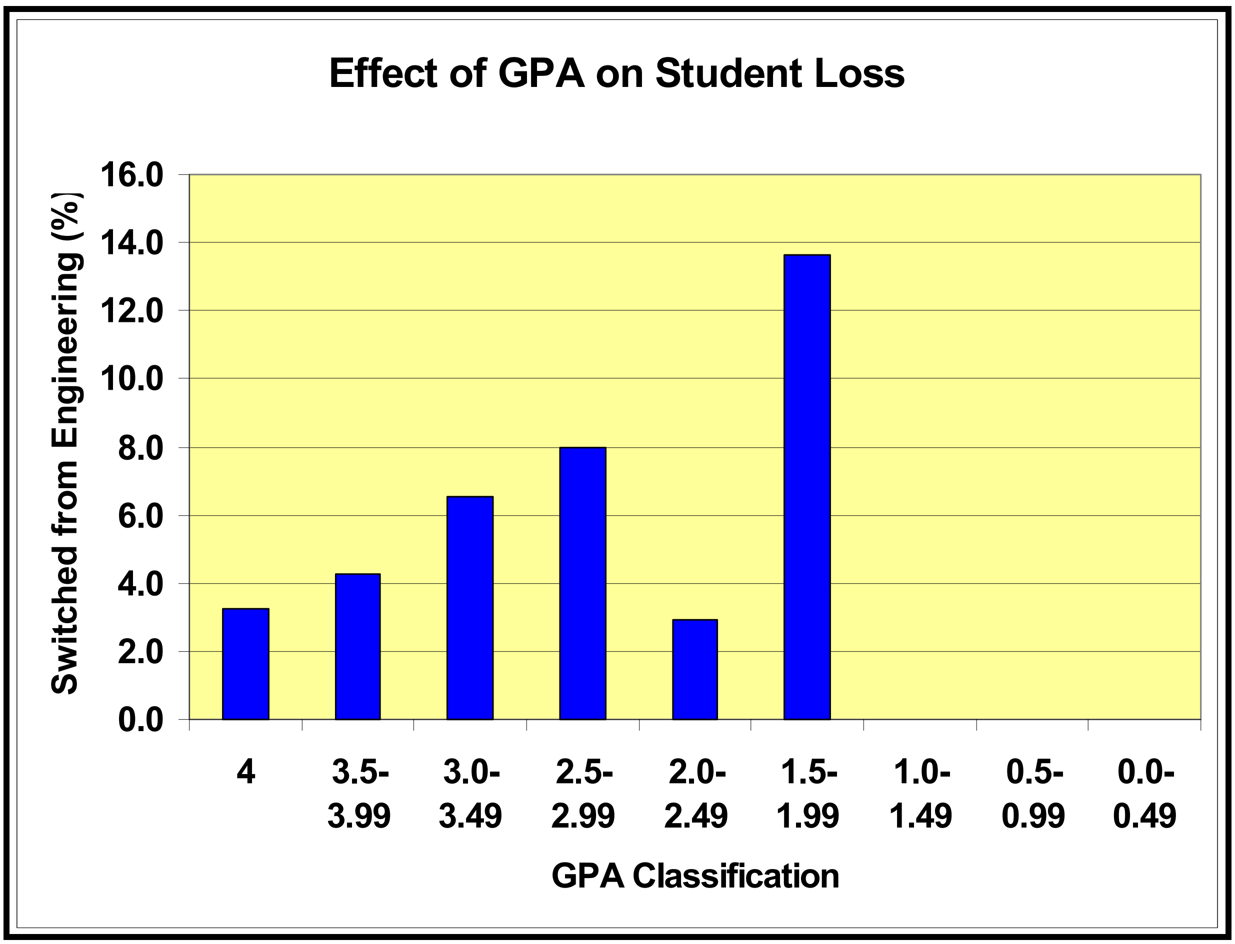

Figure 1. Relationship of GPA and the percentage of students who switched from engineering.

Performance Associated with Major Selection

We originally programmed the Excel sheet to order the 10 majors within engineering from best to worst fit. We also programmed the sheet to indicate by color if an engineering major was a good fit (green), acceptable fit (yellow), or not a good fit (red). The value of students being in an engineering major with a green or good fit is shown in Figure 2. A green or good fit was considered a correct major. From Figure 2, it is clear that being in a correct major has value in reducing the number of students who switch from engineering. This figure only contains data for GPA's above 2.0. The trend of this curve does not hold for students who are in academic difficulty—further evidence of the statements in the above section. The one point in Figure 2 that seems to be off the general trend is the 4.0 GPA group. It appears that students who make a GPA of 4.0 are less likely to switch majors than other students even if they might be in the wrong major. The result for the 4.0 GPA group removed is shown in Figure 3.

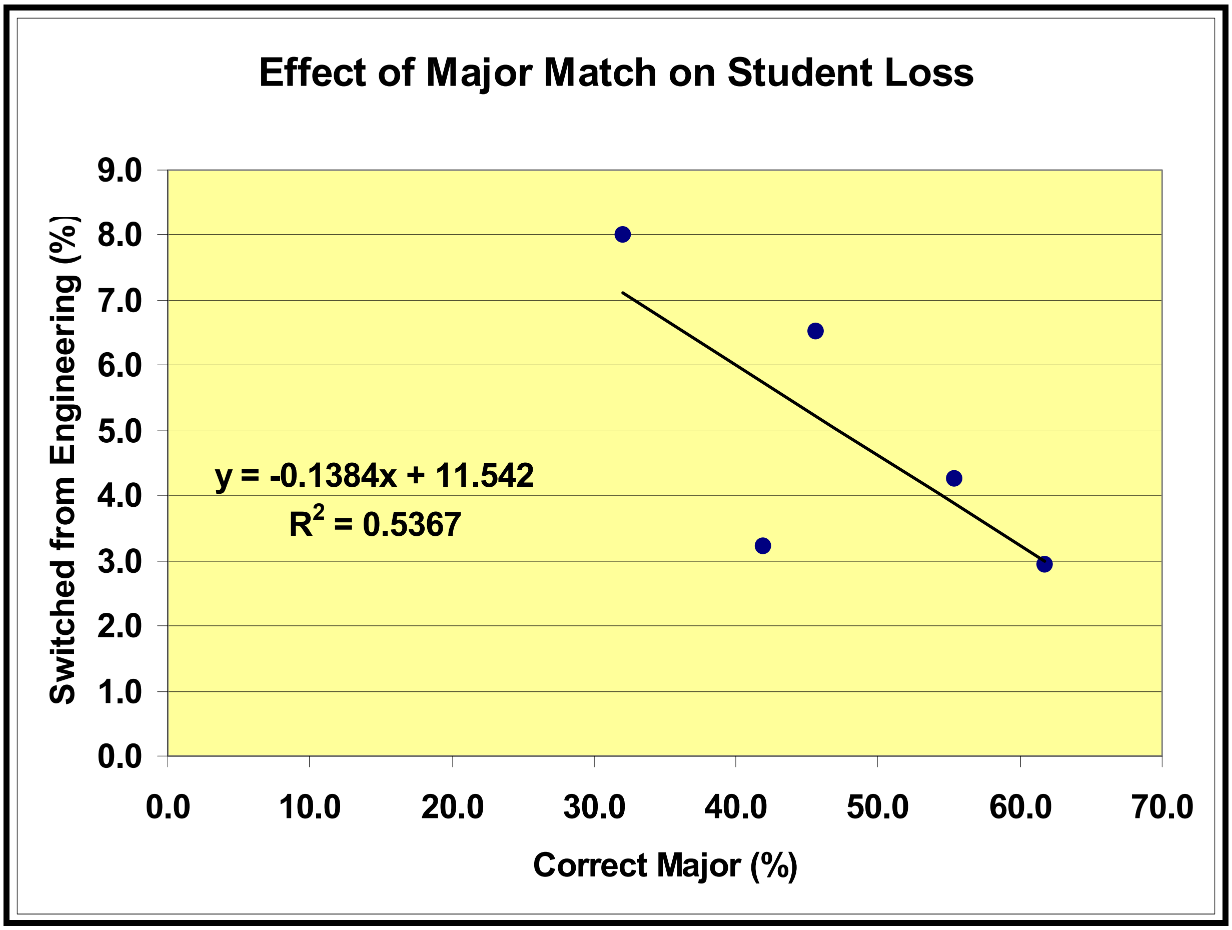

Figure 2. Value of being in correct major on reducing student loss.

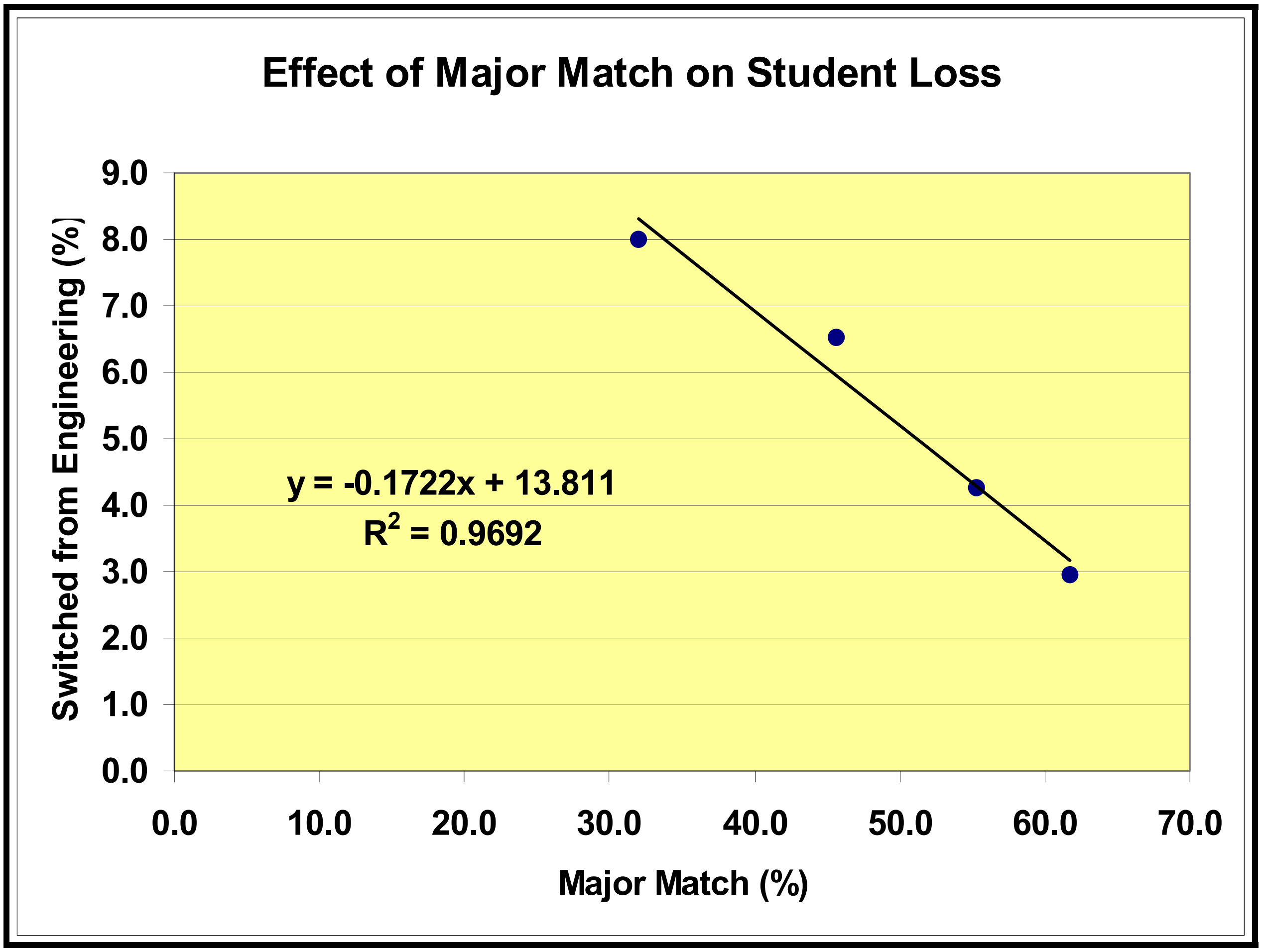

Figure 3. Strong relationship showing value of being in correct major.

Thus, there is a strong relationship between the number of students who switch from engineering and their major match for students earning a GPA between 2.0 and 4.0. An R^2 of 0.97 is certainly statistically significant ($\alpha = 0.5$). This relationship seems to verify that the process both works and has value to help improve student retention.

Surprise Result

The association of extremes in learning style and loss of students is shown in Figure 4. These results were unexpected. Based on the earlier experience in dealing with students returning from suspension, we expected student loss to be increased for students with extremes in learning styles. As seen in Figure 4, this is not the relationship observed. The opposite, instead, is true. Students with extremes in learning style were most prevalent in the 4.0 GPA group and the 1.5 – 1.99 GPA group (Figure 5). Figure 4 includes students from 1.5 GPA through 4.0 GPA. While the R^2 is only 0.77, the relationship is statistically significant ($\alpha = 0.05$).

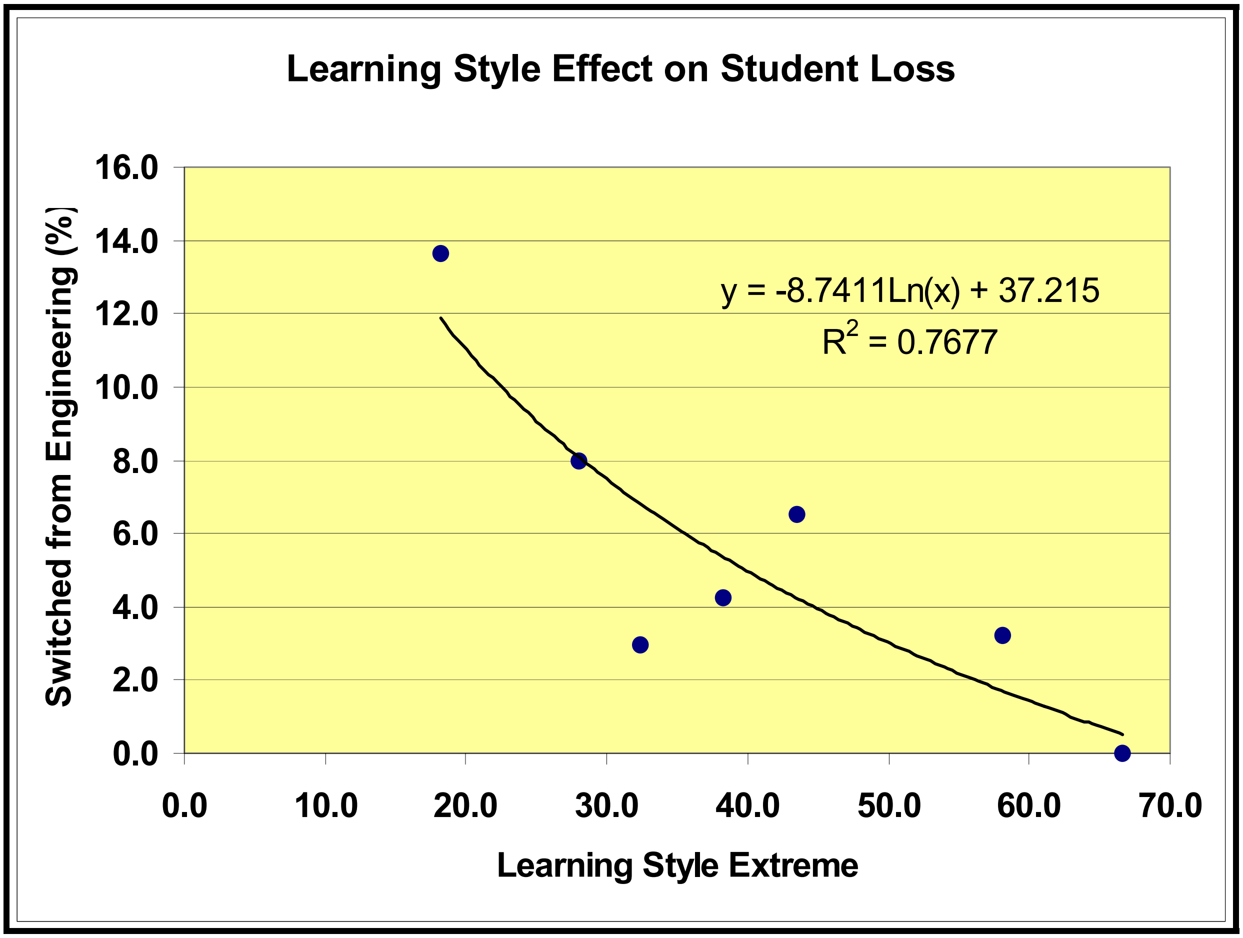

Figure 4. Relationship between extreme learning styles and student loss.

Both Figures 4 and 5 reveal that having an extreme learning style is a benefit in reducing the number of students switching from engineering if the GPA is above 2.0. It is interesting that the percentage of students in the 1.5 to 1.99 GPA range with an extreme learning style is 67 percent, which is not too different from the 83 percent observed for students returning from suspension as discussed earlier.

In another study[3], the learning styles have been surveyed for various majors. These results are shown in Figure 6. Engineering has a pattern of preference for somatic or hands on learning and holistic visual. Engineers prefer not to learn by hearing and reading. The extreme pattern is to the right of the pattern typical for engineers shown in Figure 6. It appears that a high number of engineers have this pattern and that the pattern can be either a good thing or can lead to interference in academic performance.

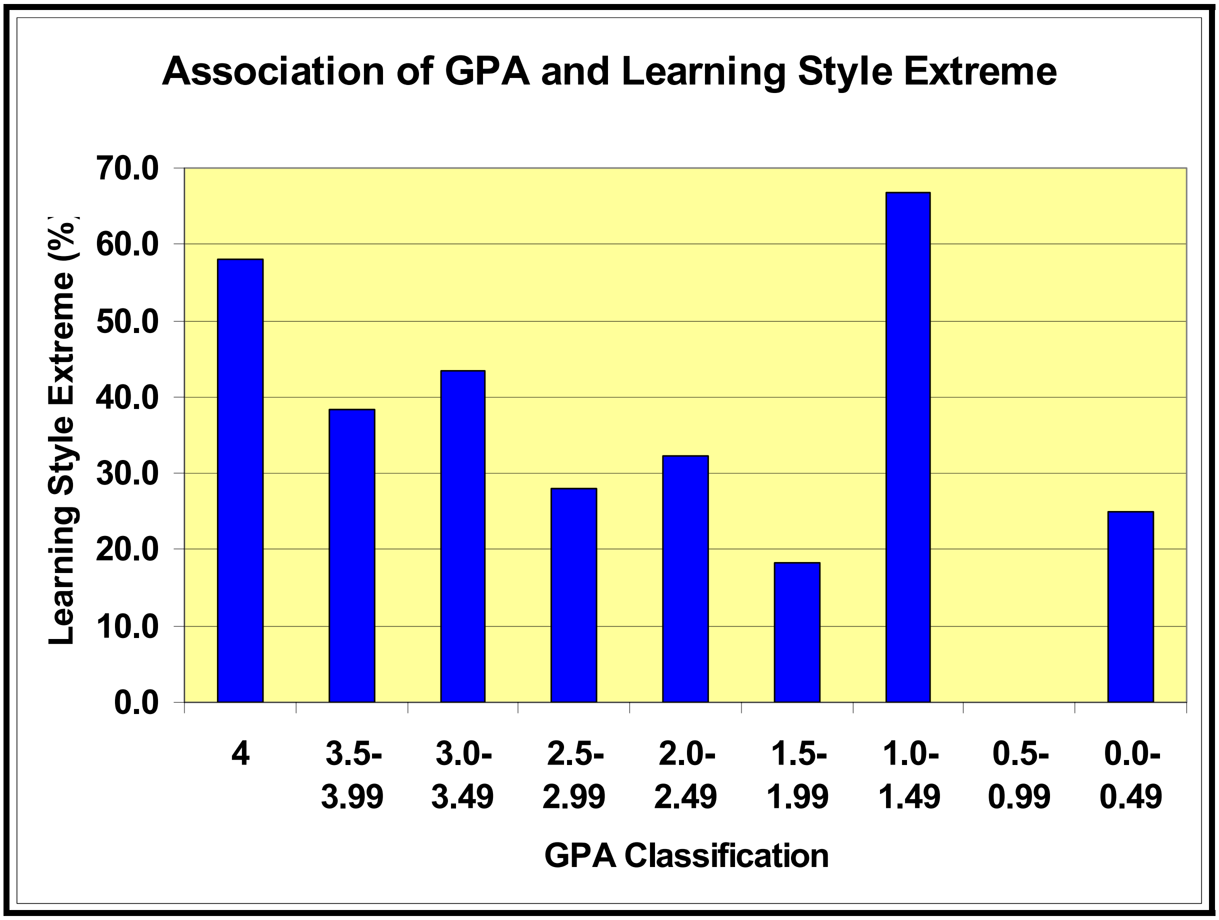

Figure 5. Relationship of GPA and extreme learning style.

Summary and Conclusions

Opportunities exist to improve the process of selecting a career and major. The selection of a general career can be aided with the career map and learning style assessment tools available with **ED DOCTOR**. Additional precision for majors within engineering can be obtained with a simple survey form presented with this paper. This process has been well received by perspective students, their parents, and undecided-engineering students. With the adoption of this process, the number of undecided engineering majors has decreased. The process has become a valuable tool to the College of Engineering. The process is also universal in principle and could be adapted to sort majors in other colleges.

The loss of students from engineering switching to other majors after the first semester was related to the match of major within engineering. Losses were also associated to extremes in learning style. The results to date indicate that retention in engineering is related to how well a student matches his major as well as GPA earned during the first semester.

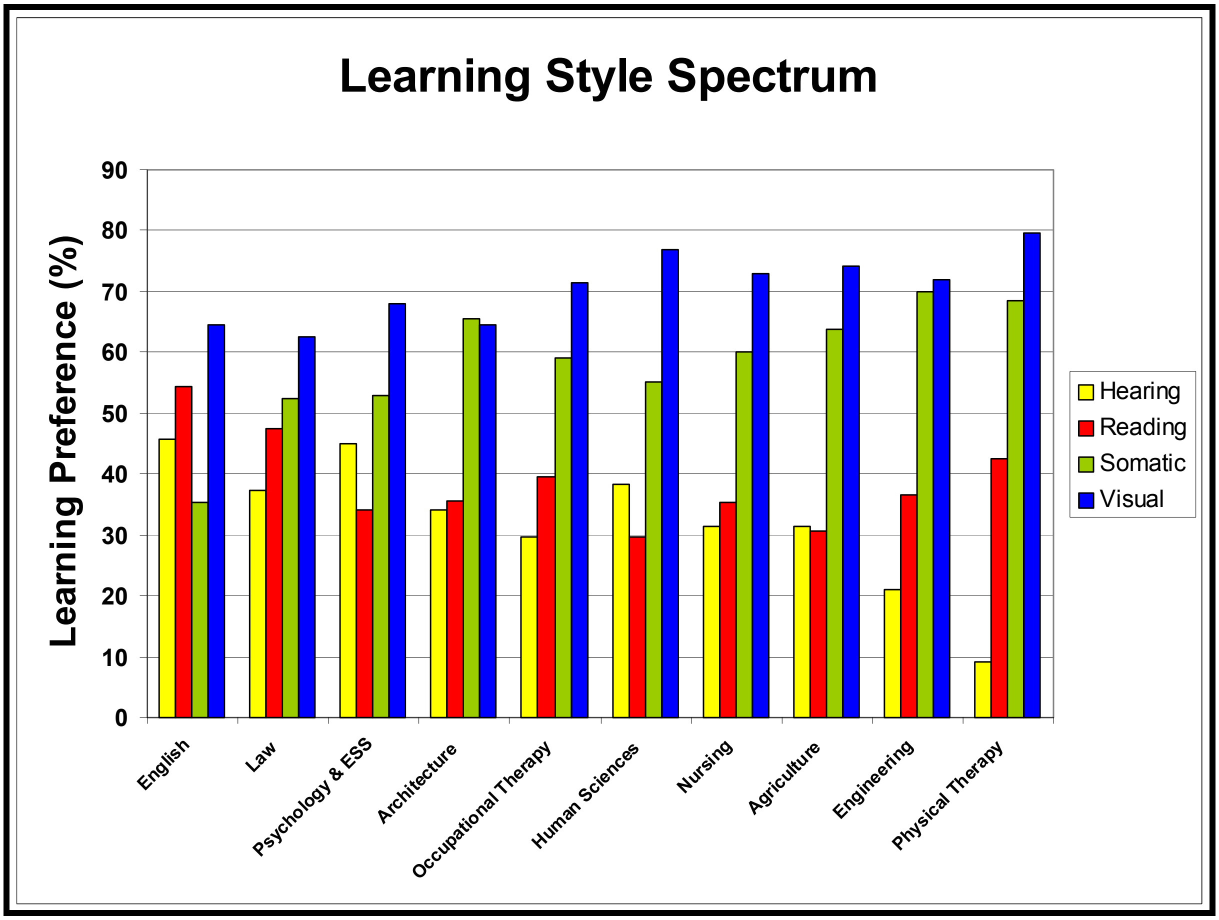

Figure 6. Typical learning style or spectrum for various majors[3].

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3. Gregory, J. M. and V. R. Barefield. 2002. Mathematically Defining the Nature of and Engineer (Gulf-Southwest Section), Lafayette, Louisiana.

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Appendix

Engineering and Computer Science Career Planner

Name:________________________________ **SS#:**__________________

Circle Current Major: CH E CE CMPE CS EE ENUD ENPH
IE ME PETR CTEC ETEC MTEC

Web Site for Career Analysis: **http://edtool.coe.ttu.edu/eddoc**

Career Map: Things/People:______ Data/Ideas:______

Learning Styles: Hearing:______ Reading:______ Somatic:______ Visual:______

Order of Things

Order the following from most preferred to least preferred by placing a number from 1 (most preferred) to 30 (least preferred) in each box. Use each number only one time.

☐ Fuels	☐ Refineries	☐ Chemistry
☐ Oil	☐ Geology	☐ Energy sources
☐ Systems	☐ Management	☐ Car and other manufacturing
☐ Cars	☐ Airplanes	☐ Engines
☐ Buildings	☐ Highways	☐ Water systems
☐ Water quality	☐ Air quality	☐ Environment
☐ Electric power	☐ Electronics	☐ Com. Chip design
☐ Programming logic	☐ Software design	☐ Data manipulation
☐ Physics	☐ Instrumentation	☐ Science theories
☐ Making things work	☐ Practical Applications	☐ Hands-on work