Gaining Retention and Achievement for Students Program (GRASP) A Professional Development Program for Engineering Faculty To Increase Student Success

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Abstract

Faculty are often frustrated by students' poor academic performance and experience high student withdrawal and low student retention. Faculty present good lectures, assign appropriate homework, answer students' questions, and believe students understand the material. In spite of the time and effort faculty spend in preparation, faculty are often surprised to see students' poor performance on assignments and exams. After the excitement of getting to know a new group of promising students, faculty are disappointed when students drop their classes. Faculty blame poor performance on students' lack of academic preparedness and often believe they can do little about student success. The reality is, faculty *are* able to take actions to improve student academic performance and increase student retention. Teaching *is* more enjoyable when faculty see student success. This paper discusses how making small changes in faculty teaching can make big differences in student retention and academic performance.

Gaining Retention and Achievement for Students Program (GRASP) is a professional development program for engineering faculty which can be implemented at most engineering colleges. A fundamental assumption of the GRASP program is faculty are critical to student retention and achievement. GRASP focuses on modifying faculty teaching behaviors proven to increase student retention and achievement. GRASP does not attempt to change what is taught by faculty. GRASP does support faculty changing teaching methodologies to target student needs. The intent of the program is to bring about a systemic change in the engineering professors' teaching practices.

Analysis of student grades and retention revealed an average increase of 4% in both student retention and achievement. Increasing student retention and achievement by 4% can have profound and lasting effect on program enrollment. Engineering programs interested in increasing student success can implement GRASP on their campuses.

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The Faculty Development Program

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The GRASP program in the College of Engineering at New Mexico State University focused on modifying faculty teaching behaviors proven to increase student retention and achievement. Two components of GRASP were data analysis of student learning styles and faculty implementation of alternative teaching strategies. GRASP included several components:

- $ Students completed two learning style surveys. The results of the surveys were given to students along with information about successful learning strategies to support students' particular learning styles. The survey results were also given to the faculty along with information about successful teaching strategies to support their students' learning styles.
- $ GRASP staff observed classes weekly and determined where alternative teaching strategies could be incorporated into the lecture to support students' learning styles.
- $ GRASP staff and faculty discussed alternative teaching strategies based on data collected during observations.
- $ Faculty incorporated suggested teachings strategies into their courses.

Student Learning Styles

Strategies used to improve student achievement included measuring and addressing two broad categories of student learning styles; sensory learning styles and interactive learning styles.

Sensory learning styles are the senses students use to process new information.
Sensory learning styles include:

- $ Visual: Students who learn best when they see information (on the board, in diagrams, reading books)
- $ Auditory: Students who learn best when they hear information (lectures, discussions, oral directions)
- $ Tactile: Students who learn information best when they touch something (in laboratories)
- $ Kinesthetic: Students who learn best when physically moving (biking, walking, exercising)

Interactive learning styles are the way, and with whom, students interact when they learn. Interactive learning styles include:

- $ Student-Faculty-Formal: Students who learn best by interacting with the faculty during class
- $ Student-Faculty-Informal: Students who learn best by interacting with faculty outside of class (after class, during office hours, through email or phone)
- $ Student-Student: Students who learn best by interacting with other students (both during class and outside of class)
- $ Self: Students who learn best by not interacting with the faculty or other students either during or between classes

Faculty Teaching Strategies

After each observation, GRASP staff and faculty discussed observations and suggested teaching strategies. GRASP staff and faculty held monthly meetings to discuss how faculty implemented the recommended teaching strategies during class and the results of these changes. Faculty used the following teaching strategies:

Classroom Teaching Strategies:

- $ Learn and use student's names, inside and outside of class
- $ Provide opportunities for students to interact with other students during class
- $ Have students put problems on the board or have students explain a problem while the faculty writes the solution on the board
- $ Provide lecture notes before class
- $ Ask students to re-state the material during class

Specific Achievement Strategies:

- $ Teach students to how to create test questions
- $ Correlate grades, interactive style and frequency of interactions in and outside class, and use the information to individually assist students to improve grades, attendance, homework completion, etc.
- $ Personally invite students to visit during office hours
- $ Tell students what they need to do to be prepared for class, tests, and quizzes
- $ Talk to students with "border-line" grades with the intention of moving students' grade up one grade level

Positive interactions to promote learning:

- $ Use complex questioning process during class - eliminate the use of simple questions with yes/no answers
- $ Analytical feedback - tell students why the answer is correct or incorrect
- $ Wait time/think time - wait three seconds after asking a question for students to respond. This allows students to think and tells them participation is expected.

$ Probing questions - ask multiple questions to the same student on a single topic. Faculty guide the student through a thought process which leads to an appropriate response.

Working with Students Who Learn Alone

Students who learn by themselves can be very successful, but they are presented with a problem. These students must be able to teach themselves the necessary material since they do not go to faculty or other students for help when they can not solve an engineering problem. While many of these students may have been able to graduate from high school without needing help from their teachers or fellow students, few engineering students can complete an undergraduate engineering program in isolation. Seymour and Hewitt[1] found 16.9% of students who left engineering and science majors had not worked with their peers to gain a better grasp of the material they found difficult; and, 11% said they considered this to have contributed to their leaving the field. As part of GRASP, Faculty encouraged students who preferred to learn by themselves to interact with their faculty or other students when they find the curriculum difficult to master.

Faculty reviewed student grades throughout the semester. If students were Self interactors and appeared to be having difficulty with the course material, faculty talked to the students and suggested the students use university resources to improve their study skills, get support for test anxiety, or information about time management. These students were also encouraged to join study groups or come to office hours. Universities don't want to lose these talented students simply because these students are unable to teach themselves difficult engineering material.

Working with Students Who Learn With Other Students

There is a growing body of literature suggesting the idea that working with other students supports student learning.[2-8] As part of GRASP, faculty were encouraged to organize student groups for projects, group homework assignments, or study groups. Faculty set aside time during class for students to work with each other on engineering problems. An effective way to do this was to end class with an in-class assignment. Following the lecture and problem solving exercises by the faculty, students were given a similar problem to solve before leaving class. Students asked the faculty questions, or worked with other students. This strategy assured every student understood how to start the homework assignment before leaving the class.

Working with Students Who Are Informal Interactors

While many engineering programs are including team work and group work as part of their curriculum, few are incorporating informal faculty interaction. This type interaction can take place after class, before class, during office hours, in the hallways, over the telephone, or through

email. The interaction can pertain to research, homework, academic planning, or career opportunities. This interaction can take place one-on-one, or as part of a group. What is important is the student understands the faculty is speaking and listening to him/her. As part of GRASP, faculty encouraged students to interact with them in an informal environment, in an academically meaningful way.

The easiest way for faculty to do this was to be last one out the door after class. Many faculty have the experience of answering everyone's questions before dismissing class, then having a line of students at their desk with a question directly after class. Faculty should not be discouraged by this. Interacting with faculty directly after class is a form of informal interaction. Being available for questions directly after class, was an effective method for faculty to support those students' learning who are informal interactors.

Another method to support students who learn best by interacting with faculty outside of class was for faculty to personally ask students to come to office hours to discuss a quiz, homework assignments, or a test. Some students, especially freshman, don't understand faculty welcome students during office hours. By personally inviting students to come to office hours, faculty encouraged student learning. This was especially important if a student's grade was not acceptable. Faculty who reviewed student grades early in the semester and spoke to the student about ways to improve their grades, were able to help students raise their grades.

Working with Students Who Are Formal Interactors

Students interacting with faculty during class is a significant interactive style that must be addressed if student learning is to be maximized. Some engineering classes are non-interactive in nature. Some classes are structured with faculty lecturing and solving problems on the board. Studies have found only 8% of students speak two or more times during class,[9] and over half of students do not contribute a single interaction during class discussions.[10] The most important factor in students interacting with the faculty during class, is their perception that faculty are "willing" to do so.[11]

Both faculty and students need to know what students don't understand before leaving class. Students focus on taking notes or copying problems during class, and may not take the time to process the material. When asked during class if students have a question, many times they don't, because students haven't thought about the problem yet, they just copied it down. When students do homework, some realize they didn't understand what was presented in class. A few simple changes in faculty teaching strategies can increase student interaction in class.

Interactions in class were increased when faculty called students by name, waited for students to think and answer before moving on, or allowed students to discuss a difficult engineering concept with another student or group of students before discussing it as a large group. Instead of asking if students had a question about what was presented, faculty asked a student to re-state the material. If students had a question, it is more likely to appear when they were discussing the material rather than copying the material.

Many freshman courses are large, introductory courses which are not set up to encourage interactions. Introductory-level instructors agree their job is to provide the basics for future education and give as much information about the subject as time allows, so students are prepared when they take higher-level courses.[9] Lack of interaction in freshman courses may be contributing to the loss of engineering students between their freshman and sophomore years. Faculty teaching introductory courses were encouraged to use teaching strategies to facilitate students asking questions during class and allow for student discussions.

Methodology

Participants

The program included 25 selected engineering courses at New Mexico State University, the 25 faculty who taught the courses, the 904 engineering students who were registered for the selected courses and the 822 engineering students in the control classes. Faculty were recruited who were willing to allow observation in their classes and were willing to incorporate the suggested teaching strategies into their classes. Faculty who were teaching the freshman and sophomore courses were approached, although some participating faculty were teaching upper classmen. Participation of some faculty was recommended by their department head or dean. However, all faculty participation was voluntary. There were six electrical engineering courses, three mechanical engineering courses, four chemical engineering courses, five civil engineering courses, six engineering technology courses, and one industrial engineering course. The control group was the students enrolled in the same course, taught by the same faculty, the semester before the faculty participated in GRASP.

Data Collection

The first day of class, students completed an Interactive Learning Style Survey and a Sensory Learning Style Survey. The students indicated their learning preferences as one or more styles. Faculty were made aware of their students' learning styles so faculty could implement alternative teaching strategies to support the various learning styles of their students.

GRASP staff observed classes approximately once a week, and noted who was interacting, in what way, and at what level, during class and directly after class. Faculty were also given this information in an effort to address the students' interactive styles.

GRASP staff met with the faculty to discuss observations and various alternative teaching strategies which could increase positive interactions. Working with GRASP staff, faculty made an effort to implement suggested alternative teaching strategies. If a student's grade indicated s/he was having trouble with the course content, and the student was not participating in class or interacting with the faculty outside of class, GRASP staff and faculty discussed ways to include this student.

After the academic semester was completed, analysis was made of student grades, analyzing the number of students passing the courses during the research semester compared to previous semesters. Also considered was how many students were still engineering majors one year after participation in the program.

Results

Increase in Student Retention

There was an average increase of 4% from pre- to post-GRASP in student retention. Faculty have increased retention in a single course by as much as 25%. Retention was measured through a pre- and post-GRASP comparison of students enrolled in engineering programs one year after GRASP participation. Chi square analysis determined this increase to be statistically significant at the .05 level.

Increase in Student Achievement

There was an average increase of 4% from pre- to post-GRASP in student achievement. Chi square analysis determined this increase to be statistically significant at the .05 level. Faculty participating in GRASP increased student achievement in a single course by as much as 21%. Achievement was measured through a pre- and post-GRASP comparison of students' final grades. Analysis compared the final course grades of the students enrolled during the GRASP semester to the final course grades of the students enrolled in the same class, taught by the same faculty, before the faculty participated in GRASP.

Conclusion

As students, faculty may not have learned by interacting in class; but, their students may. Faculty do not have to teach the way they were taught. Faculty can make a decision to set up their courses to encourage a variety of interactions and support a variety of learning styles. Since student learning styles can be measured, faculty can create a classroom environment which supports their particular students' learning. Providing multiple types of teaching strategies is helpful in creating successful learning opportunities for all students.

In the present study, a faculty development program was explored as an avenue to increase student retention and achievement. This program offered continuous support to faculty over an entire academic semester in an effort to increase the use of a variety of teaching strategies. By meeting with the faculty over the semester and discussing teaching methodologies, faculty did expand teaching strategies. Faculty increased the use of positive interactions with and among students, both during and between classes. Analysis of student grades and retention revealed an average increase of 4% in both student retention and achievement.

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