

Power Groups for Engineering Students: An In-depth Study of Results

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Abstract

In 1995, the University of Wyoming implemented clustered scheduling for new engineering students, through Power Groups. Power Group students are scheduled in common sections of Calculus, Chemistry, English, Introduction to Engineering Computing, and Orientation to Engineering. For the 50 - 70 students who have elected to participate in Power Groups each of the past five fall semesters, academic performance is increased and they choose to remain in engineering longer than the students who are non-participants. Clustered scheduling is especially successful for students in underrepresented groups; female and ethnic minority students in the Power Groups have significantly higher GPAs and a higher retention in engineering majors. Clustered scheduling is a relatively low-cost, effective strategy for increasing the retention of engineering students.

Introduction

Student retention can be improved through a variety of strategies. One such strategy, the *community building* model,¹ has produced impressive results for minority student success. This model promotes a high level of collaborative learning by clustering students in common sections of courses and offering a freshman orientation course, structured study groups, and a student study center. Given the overwhelming success that has been achieved in minority engineering programs nationwide, the University of Wyoming has implemented components of the community building model for all students.

According to Landis, the single most effective and essential component of the community building model is common course scheduling. Even though it is generally agreed that common scheduling is a key component, few institutions implement the scheduling. Common scheduling has been implemented at UW through Power Groups, clusters of approximately 20 freshmen students.²

Additional components of the community building model have also been implemented at UW. Two orientation courses, Orientation to Engineering and Introduction to Engineering Computing, expose students to computer tools to improve their academic productivity, provide academic survival skills, and introduce them to the engineering profession. Structured study groups have been used to guide students in using cooperative learning techniques. Students participating regularly in the study groups have improved exam scores and report increased self-confidence with the course material.

Another successful retention strategy at UW is a living / learning environment in the residence halls,³ based on the highly successful theme floors offered by many housing departments on

campuses across the nation. Since the first students were selected to live on the Engineering Floor the Fall 1995 semester (the same time Power Groups were implemented), an ever-increasing number of students are choosing this arrangement, which is an indicator of the success of this program. Creating an environment where the students can conveniently interact and are comfortable doing so is an essential condition to promoting collaborative learning. Clustering students in a living environment is an obvious solution to creating this environment. It is interesting to note that many of the Power Group students also choose the Engineering Floor for their living arrangements.

Power Groups

Beginning the fall of 1995, students entering the college of engineering were given the opportunity to participate in a pilot project adopted from the *community building model*. This model advocates clustering students, i.e. enrolling groups of students in common sections, so the students have the same homework, exams, and course preparation. Students in common sections can conveniently share information, and thus benefit through collaborative learning.

Since all new engineering students at UW are required to take Introduction to Engineering Computing, this course was chosen as the basis for clustered scheduling of Power Group students. Membership in the Power Groups is further restricted to students enrolled in Calculus I or higher, which is approximately 100 students. The Computing course is offered in 10 sections to approximately 250 students. Half of these sections are thus targeted for clustered scheduling, providing the requisite 100 “seats” for the students eligible to participate in Power Groups. Each fall, between 50 and 70 new students enrolled in Calculus I have chosen to participate in Power Groups. The remaining students enrolled in Calculus I who are eligible for Power Groups but do not elect to participate, constitute the “control group” (Non-Power Group) and are randomly scheduled in other sections of the same course. Another 30 to 40 students enrolled in higher level math classes will also participate in the Power Groups, but are excluded from this study because they are not in Calculus I.

Along with the Introduction to Engineering Computing course, common scheduling also includes Calculus I (or higher level math), Chemistry, English Composition, and Orientation to Engineering. The cooperation of the Mathematics, Chemistry, and English departments, which was essential in developing the clustered scheduling, was obtained through joint meetings to address issues and perceived problems. In response to concerns from the English department that the sections should represent heterogeneous groups of students, no more than 10 students are clustered together in the English classes; hence each Power Group is assigned to two different Composition sections.

Most of the students who enroll in the Power Groups do so during New Student Orientation, conducted during the summer. These students are given information on the groups and their advantages. Since registration occurs continuously over the summer, the registrar has set up a procedure to “block” the Power Groups for students who elect to participate, and these students are registered manually. This is relatively easy to do for approximately 100 students, but may present a challenge for larger schools.

Given the success of the Power Groups, an additional Power Group was initiated this fall for

students enrolled in a pre-calculus Algebra and Trigonometry course. This is traditionally a higher risk cohort of students. These students are not eligible to enroll in the Introduction to Engineering Computing course, but are scheduled for common courses in Chemistry, English Composition, and Orientation to Engineering.

For many institutions, implementing a common course scheduling system for new students is a relatively low-cost, low-maintenance intervention for increasing student retention. The advantages include not only an increased level of cooperative learning that occurs spontaneously among the students, but also the opportunity for faculty to gain a more complete picture of student progress. When a student is struggling in one course, that student may also be experiencing difficulty in another course. At UW, the faculty teaching each of the courses in a Power Group meet periodically and share concerns about individual student situations as well as solutions.

The University of Wyoming will be examining the use of Power Groups as a basis for an integrated curriculum. Since the students are scheduled in common courses, the faculty are also common. This facilitates coordinating material presentations, assignments, and class projects.

Results

Table 1 details the characteristics for students eligible for membership in the Power Groups each fall since the inception of the program; it should be noted that only students enrolled in Calculus I are eligible to participate. Characteristics for the Algebra / Trigonometry Power Group added Fall 1999 are also included.

Table 1: Characteristics for Power/Non Power Group Students

Students Enrolled in Calculus I							
	Number of Students			High School GPA		Composite ACT Score	
	PG	Non PG	Total	PG	Non PG	PG	Non PG
Fall 1995	67	47	114	N/A	N/A	N/A	N/A
Fall 1996	67	30	97	N/A	N/A	N/A	N/A
Fall 1997	51	32	84	3.73	3.54	27.2	25.9
Fall 1998	52	39	91	3.61	3.63	26.1	25.2
Fall 1999	61	29	90	3.32	3.56	26.1	26.1
Students Enrolled in Algebra/Trigonometry							
Fall 1999	16	32	48	3.50	3.28	21.2	21.0

N/A = not available

PG: Power Group / Non PG: Non Power Group

Even though high school GPAs and composite ACT scores are not readily available prior to Fall 1997, it is fair to assume from the remaining data that Power Group students are not statistically different from non Power Group students.

The following figures (Fig. 1 – Fig. 3) illustrate the performance of the students in Calculus Power Groups and Non-Power Groups for three categories: Average GPA, Average credit hour load, and Fall – Spring retention. Examining these charts shows that the average GPA for the

Power Group students exceeds that of the Non-Power Group students, while these students are also carrying a significantly higher course load. Further, the fall-to-spring retention of the Power Group students is generally higher than the Non-Power Group students. The second year of the program, 1996-97, is an anomaly, but overall the results attest to the success of the program. It is also interesting to note that the Fall 1999 Power Groups had lower high school GPAs but outperformed the Non Power Group students.

Figure 1, Semester GPA

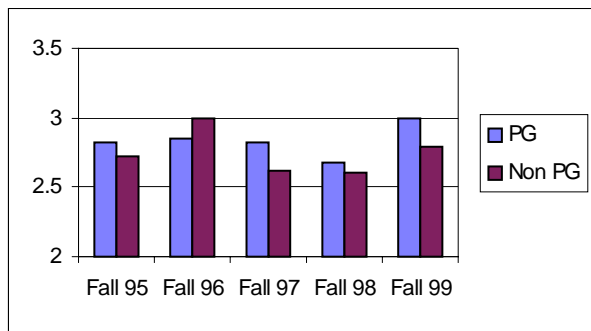


Figure 2, Credit Hours Earned

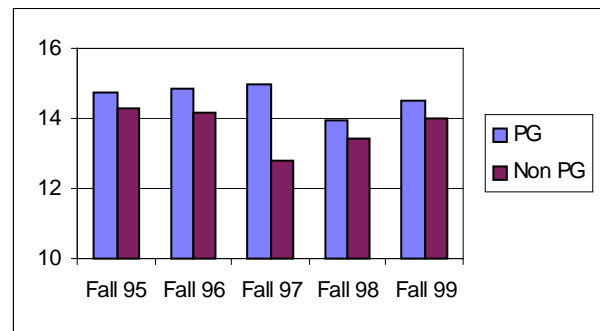
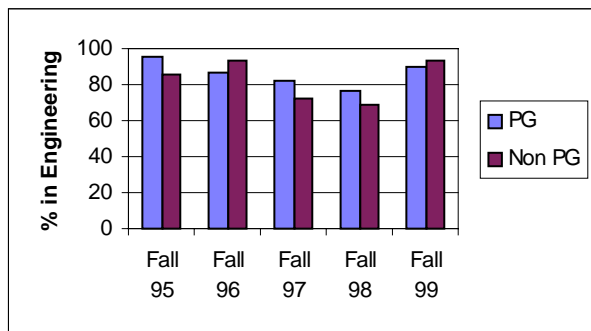


Figure 3, Fall to Spring Retention



Figures 4 – 6 illustrate the performance differences accumulated over the past five years between Power Groups and Non-Power Groups for gender and ethnic cohorts. These data indicate that Power Groups are especially effective for students in underrepresented populations. The average GPA for male students is almost identical for Power Group and Non-Power Group students; however both female and minority students participating in Power Groups have significantly higher academic performance as well as increased retention in engineering majors.

Figure 4, Semester GPA

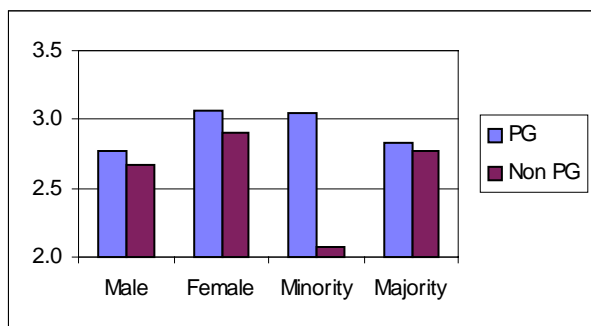


Figure 5, Credit Hours Earned

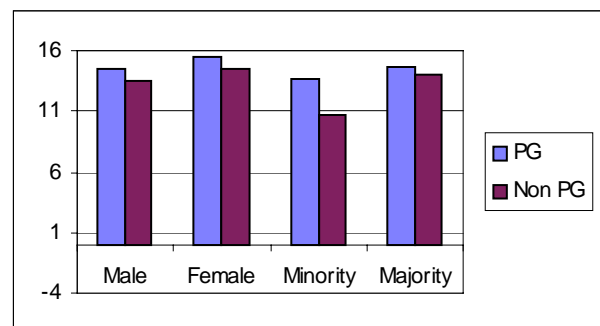
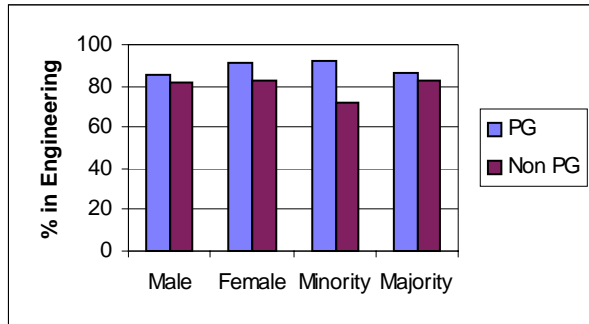


Figure 6, Fall to Spring Retention



Finally, the results for the new Algebra / Trigonometry Power Groups are very promising. This at risk group for retention within engineering major achieved higher GPAs and were retained in engineering at significantly higher retention rates.

Table 2: Algebra / Trigonometry Power Group – Fall 99

	PG	Non-PG
Average Fall GPA	2.70	2.45
Average Fall Hours Earned	14.4	14.2
% Engineering Fall to Spring	93.8	75.0

Conclusions

Since the first component of the community building model was implemented at the University of Wyoming, the retention of freshmen engineering students has consistently exceeded 75%. Each of the components has contributed to this success, but the implementation of Power Groups has had the most profound effect on student retention. The Power Group concept, however, is significantly strengthened when coupled with cooperative learning techniques, ensuring more frequent interaction between students. Anecdotal reports from students in Power Groups indicate that they develop study groups on their own and jointly plan common schedules for the spring semester. Clustering, through the use of Power Groups, has indeed proven to be an effective mechanism to increase student retention in engineering and is an extremely successful strategy for improving individual student academic success.

Bibliography

¹ Landis, Raymond, "Building Collaborative Learning Communities," *Proceedings ASEE Conference*, 1990 pp. 1204 - 1208.

² Steadman, Sally J, Bruce R. Dewey, and David L. Whitman, "Power Groups for Engineering Students", *Proceedings WEPAN/NAMEPA 1997 Joint Conference Annual Conference*.

³ Steadman, S., and D.L. Whitman, "Residential Innovations for Engineering Students", *Proceedings ASEE Conference*, 1999.

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Dr. Dewey is a graduate of Iowa State University (B.S. in Mechanical Engineering, 1959, and M.S. in Nuclear Engineering, 1964) and the University of Illinois (Ph.D. in Theoretical and Applied Mechanics, 1967). In 1982, he moved to UW. He has worked as a consultant and research collaborator for Union Carbide, Oak Ridge National Laboratory, General Electric, Lawrence Livermore Laboratory and Pafec, Ltd. His research interests are in finite element analysis, ultrasonic wave phenomena, solid modeling and computer graphics. He is author of the text, *Computer Graphics for Engineers* and is a member of ASME, ASEE, Sigma Xi, and IEEE Computer Society.