

## **IMPACT ASSESSMENT OF AN SEM RESIDENCE HALL: Does it really affect the success of students in science and engineering?**

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The Committee on Women in Mathematics, Science and Engineering collaborated with Residence Life (the unit on campus responsible for programming and staffing in residence halls) to initiate the Science, Engineering and Mathematics (SEM) Residence Hall Project at Washington State University in Fall 1991. The affect of the SEM Hall on the academic success of students in science and engineering is the focus of this study.

### **Background Information**

The SEM Hall was initiated in an effort to create an environment in which women could thrive in disciplines in which they are traditionally underrepresented. By clustering students with similar interests and demands, the hall fosters the development of the academic/social networks that support their goals. Specific benefits for students in the hall include the following.

- The support of living with others who share their interests and ambitions.
- Being surrounded by potential study partners (other students enrolled in the same courses) and role models who are further along in their studies.
- In-hall programs and resources designed specifically for students interested in SEM.
- A state-of-the-art computer lab equipped with the software used in SEM classes.
- Tutor-assisted study hall located in the hall.
- Study/meeting floors on each floor.
- Resident advisors, most of whom are SEM majors.

The original concept was to have a program focused entirely on women, but through student input it evolved into the coeducational project of today. A table illustrating the growth of the project is given below. The Hall has grown from 50 residents (25 females and 25 males) in 1991-1992 to 519 residents (213 females and 306 males) in 1996-97.

## Objectives and Methodology of the Study

This study is a first attempt to show that the SEM Residence Hall Project can enhance the success of the residents. Here success is defined as a measure of passing grades in their course work and retention in their majors. This will be accomplished by determining whether or not there are significant differences between earned grades in the first two semesters of calculus, completion percentages in the first two semesters of calculus, and retention within SEM disciplines of SEM Hall residents and of non-SEM Hall residents. The affect of other influences on the grades is also investigated.

This is an observational study as opposed to a randomized study and hence the results are reflective, not statistically conclusive. The subjects of this study were all students registered after the second week of the course in Calculus I (Math 171) during Fall 1994 or Fall 1995 or in Calculus II (Math 172) during Spring 1995 or Spring 1996. Drs. Sandra Cooper and Thomas LoFaro each taught half of the sections offered each of the four semesters. The instructors worked together closely during the semesters and common tests were given. The instructors supplied the student lists complete with the final grades earned and any withdrawal information. The students' high school GPA and major of interest (as recorded during the semester of observation) were gathered from the WSU institutional database.

The first step in the analysis is to show that the SEM Hall residents and non-SEM Hall residents are comparable groups for both Calculus I and Calculus II. This is established through comparisons of high school GPAs for the Calculus I and Calculus II students by the two groups; SEM Hall residents and non- SEM Hall residents. Next, graphs are given showing the percentages of each group that passed (earned an A, B, or C), failed (earned a D or F) or withdrew. From this we will be able to determine whether or not there are differences in the distribution of grades for the SEM Hall residents as compared to the non-SEM Hall residents.

The residence hall, however, is not the only influence upon these students. Other possible influences and interactions of these influences on the calculus grades received are explored through linear regression analysis. There is no straight forward way to identify a single influence because of individual variation and confounding of other influences not accounted for. However, some information can be gained from looking at a few of these other influences. The focus will be on gender, ethnicity, and whether or not the student is in an SEM discipline.

Finally, we will look at several categories within the SEM Hall residents and non-SEM Hall residents to assess any differences in retention in SEM disciplines between the two groups. The categories will be: withdrew from the university, stayed in SEM, and left SEM. Percentages will be determined for each category within the SEM Hall residents and the non-SEM Hall residents and they will be compared to see if there are any significant differences between the two groups.

### Analysis

First, we note that the SEM Hall residents and non-SEM Hall residents are comparable groups for both Calculus I and Calculus II. This is established through comparisons of high school GPAs for the four groups, the results of which are summarized below.

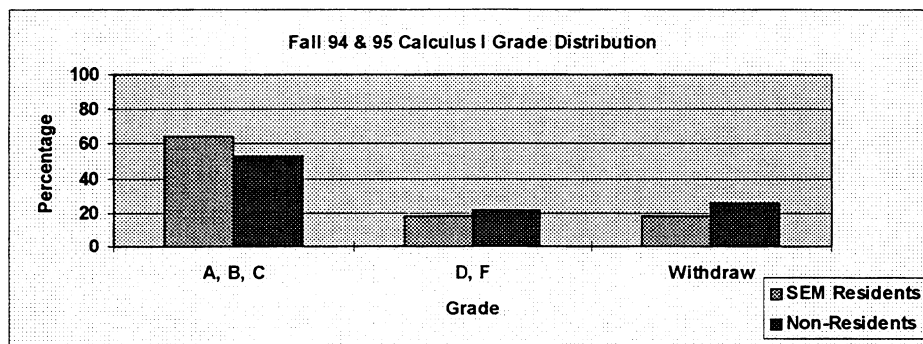
	Average High School GPA for SEM Hall Residents	Average High School GPA for non-SEM Hall Residents	Comparison statistics*	p-value
Calculus I	3.5	3.5	-.0137	0.44
Calculus II	3.5	3.5	-0.47	0.3

\* t-test for equal variances

For Calculus I, the p-value shows that there is no significant difference between the groups. Likewise, for Calculus II there is no significant difference between the groups.

### Grade analysis for Calculus I students

Below is a graph showing the percentages of SEM Hall residents and non-SEM Hall residents that passed, failed or withdrew from Calculus I in either Fall 1994 or Fall 1995.



This graph shows that SEM Hall residents received 11% more A, B, or C grades, 3% less D or F grades, and had 8% less withdrawals from the Calculus I courses in Fall 1994 and 1995 than did the non-SEM Hall residents.

The next table shows the percentages of students with SEM academic interests for SEM Hall residents versus non-SEM Hall residents that passed, failed or withdrew from Calculus I in either Fall 1994 or Fall 1995 by gender.

	A, B, C	D, F	Withdraw
Female, SEM resident	68%	12%	20%
Female, non-SEM resident	58%	21%	21%
Male, SEM resident	64%	19%	17%
Male, non-SEM resident	53%	23%	24%

This table indicates that females outperformed males. Between the women, the percentages that withdrew were almost the same, but there was a big difference in the percentages receiving failing grades. Between the men though, the differences in percentages were split between the two categories with lower percentages for the SEM residents in each category. For the passing grades, the percentage *difference* between the residents and non-residents was almost the same for the females and males.

### Other influences on the Calculus I grades

As noted earlier, the residence hall is not the only influence upon the calculus grades of these students. Other possible influences and interactions of these influences on the calculus grades received were explored through linear regression analysis. The influences considered included the residence hall, high school GPA, gender, minority status, academic area of interest, and transfer status. For the minority status, students were assigned to three categories consistent with the literature on under representation in SEM: Ethnic Minority which includes students of Hispanic, Native American or African American heritage, Ethnic Majority which includes all other ethnic groups, and Ethnicity Unknown which includes students who chose not to specify an ethnicity upon entering Washington State University (WSU) or were foreign students. Transfer status was based on whether or not the student had entered WSU as a transfer student. Many other factors probably contribute such as involvement in extra-curricular activities, mathematics background, confidence in mathematical ability, SAT scores, contact with other students, and contact with faculty members and/or teaching assistants to name just a few, but these were not investigated because of lack of availability of information.

The model used was a linear model with independent variables; high school GPA, residence hall, gender, minority status, academic area of interest, transfer status, and combinations of the above (interactions). From the many independent variables the predictors for the Calculus I grades were high school GPA, gender, gender interacting with h.s. GPA, transfer status, transfer status interacting with h.s. GPA as well as gender, minority status, and minority status interacting with h.s. GPA.

The table below provides a basis for understanding the influence of minority status. The information available is based on a small ethnic minority group and hence there is a question of whether this sample of students is representative of the larger group of minority science majors.

	<b>Ethnic Minority</b>	<b>Ethnic Majority</b>	<b>Ethnicity Unknown</b>
SEM Hall Residents	Average Grade=1.9 Standard Deviation = 1.10 Count = 7	Average Grade = 2.3 Standard Deviation = 1.18 Count = 101	Average Grade = 3.0 Standard Deviation = 0.89 Count = 11
Non- SEM Hall Residents	Average Grade = 1.5 Standard Deviation = 1.18 Count = 23	Average Grade = 2.2 Standard Deviation = 1.19 Count = 355	Average Grade = 2.0 Standard Deviation = 1.39 Count = 53

The SEM Hall did not show up as a predictor for the Calculus I grade received. The SEM Hall residents did have a projected grade increase of 0.3 over the non-SEM Hall residents, but nonetheless, the SEM Hall was not a significant influence in predicting grades.

### Retention Analysis for Calculus I students

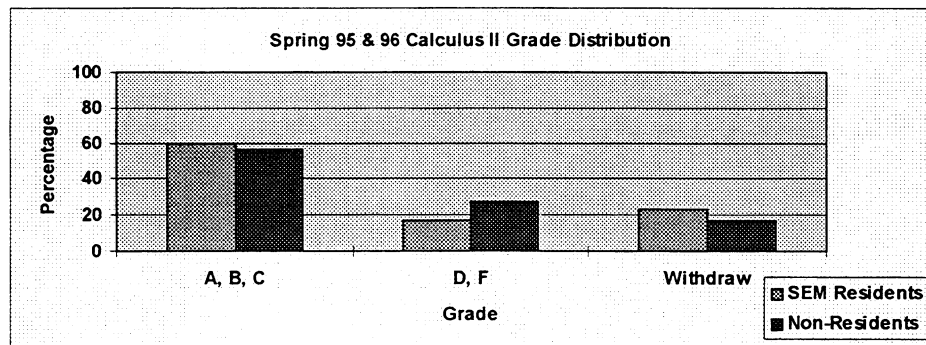
The majority of the Calculus I students have academic areas of interest which are in the sciences or engineering. These students were divided between SEM Hall residents and non-SEM Hall residents and assessed as to whether they had left WSU, had stayed in SEM, or had switched out of SEM. The table below summarizes the results.

	<b>Left WSU</b>	<b>Stayed in SEM</b>	<b>Left SEM</b>
<b>SEM Hall residents</b>	24(17%)	100(70%)	18(13%)
<b>Non-SEM Hall residents</b>	63(13%)	351(72%)	73(15%)

These results are somewhat disturbing and indicate a need for further investigation.

### Grade analysis for Calculus II students.

Below is a graph showing the percentages of SEM Hall residents and percentages of non-SEM Hall residents that passed, failed or withdrew from Calculus II in either Spring 1995 or Spring 1996.



This graph shows that SEM Hall residents received 3% more A, B, or C grades, 10% less D or F grades, and, unfortunately, had 7% more withdrawals from the Calculus II courses in Spring 1995 or Spring 1996 than did the non-SEM Hall residents.

### **Other influences on the Calculus II grades**

From the many independent variables analyzed, the predictors for the Calculus II grades were high school GPA, academic area of interest, academic area of interest interacting with h.s. GPA, and minority status.

### **Retention Analysis for Calculus II students**

Due to the limited elapsed time between the spring 1996 Calculus II course and the obtaining of the institutional data, the retention analysis does not have much meaning yet.

### **Concluding remarks**

So what does this mean in terms of the original question? Does the SEM Residence Hall affect the success of students in science and engineering? From the grade distributions for Calculus I and Calculus II, it appears that SEM Hall residents do out-perform their counterparts, the non-SEM Hall residents. However, the effect was much less evident for Calculus II than for Calculus I.

On the other hand when the influence of the SEM Hall was tested as a predictor for the grades, it was eclipsed by other factors. Background, as indicated by the high school GPA, showed up both semesters as did minority status. The high school GPA was not a surprise. The fact that minority status showed up indicates the need for a closer look at what is contributing to that as a predictor. It is also somewhat curious that gender and transfer status showed up as predictors in Calculus I, but not in Calculus II.

The retention data runs counter to what was expected. A lower percentage of SEM Hall residents stay in SEM than for non-SEM Hall residents and a higher percentage of SEM Hall residents end up leaving the university. Is this due to the fact that "at risk" SEM students are encouraged to live in the hall or to the in-hall climate?

Basically, this study raises more questions. It points to the need for more studies of this nature focusing on some of the particular questions raised by this data. It has also convinced us to continue with a longitudinal study through to graduation of the cohort identified as Fall 94 and Fall 95 Calculus I.

The questions and concerns raised by this study will be taken to Residence Life and the SEM Hall government for discussion and action.

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