

## ***Connections: A Longitudinal Study of an Integrated Freshman Program***

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### Abstract

In this paper we present evidence that an experimental integrated freshman program piloted at the Colorado School of Mines from 1994-1996 led to significantly higher graduation rates and satisfaction with their undergraduate experience for the participating students. We begin with an introductory overview of the program, *Connections*, and its goals. Then we focus on the results of a recent follow-up study of students who participated in the program, concluding with our recommendations for engineering educators based on the results of this study.

### Introduction

During the 1994-95 and 1995-96 academic years we, along with several colleagues, implemented the *Connections* program at the Colorado School of Mines (CSM)\*. When we developed the program, our primary objectives were to help first-year students to: 1) discover and develop significant connections among their first-year core subjects; 2) enhance their higher order thinking abilities and apply these abilities in humanistic, scientific, and engineering contexts; 3) understand the historical and cultural contexts which have influenced developments in science, humanities, and engineering; 4) struggle with some of the world's great ideas and issues; 5) further develop their sense of ethics and values, particularly concerning the applications and limitations of technology in the modern world; and 6) improve their oral and written communication skills.

To achieve our objectives, we modified existing required first-year courses (calculus, chemistry, physics, economics, geology, EPICS [Engineering Practices Introductory Course Sequence], and Crossroads [introductory humanities/social sciences course]) to feature a series of integrated project modules which allowed students and faculty to explore appropriate connections among these disciplines. We also implemented a two-semester *Connections* interdisciplinary seminar series in which students and faculty further developed and explored the interconnectedness of appropriate topics from each of the first-year science, humanities, and engineering courses<sup>1,2,3</sup>. No formal coursework or contact with the students extended beyond the first-year courses and seminars.

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\* Our colleagues included Dr. Barbara B. Bath, Dr. Michael J. Pavelich, Dr. Samuel Romberger, Dr. Franklin D. Schowengerdt, Dr. John Tilton, Dr. John U. Trefny, Dr. Michael Walls, and Dr. Karen Wiley.

In response to feedback from our students, the faculty involved in the program, and an outside evaluator, the program focus shifted in the second year from an emphasis on content to an emphasis on process using the model of a learning community. Anne Goodsell Love describes a learning community as faculty and students “working collaboratively toward shared, significant academic goals in environments in which competition, if not absent, is at least de-emphasized. In a learning community, both faculty and students have the opportunity and the responsibility to learn from and help teach each other<sup>4</sup>.”

Forty-nine CSM first-year students were admitted into the first pilot group (1994-95 academic year) from an initial pool of approximately 250 eligible students (those incoming students who did not have deficiencies or advanced placement credit for any of the first-year core courses). To help improve mentoring in *Connections*, a second pilot group (1995-96 academic year) was capped at 31 students in order to emphasize mentoring and forming a learning community.

Through analysis of their grade point averages, retention rates, and satisfaction with the program and CSM, we determined shortly after the end of the *Connections* project that *Connections* students were persisting in higher numbers and were generally happier with their college experience than their peers.

Because it is now six years since the first *Connections* group entered CSM, we have undertaken a follow-up study of the *Connections* participants that is the focus of this paper. For our study we examined entering test scores, graduation rates and grade point averages of the *Connections* students vs. their entering classes as a whole. We also mailed a questionnaire asking for feedback about their experience with the program to all of the *Connections* students from both classes.

#### Graduation Rates, Test Scores, and Grade Point Averages

Of the 49 students in the first *Connections* group, 36 (75 percent) had graduated from CSM within 5 years; 12 had left CSM and one is still enrolled. Of the 31 students in the second *Connections* group, 26 (84 percent) had graduated from CSM within 5 years. Five students (16 percent) had left the school. As shown in Figure 1, the graduation rates for the *Connections* students are significantly higher than the graduation rates of their CSM cohort (all first-year

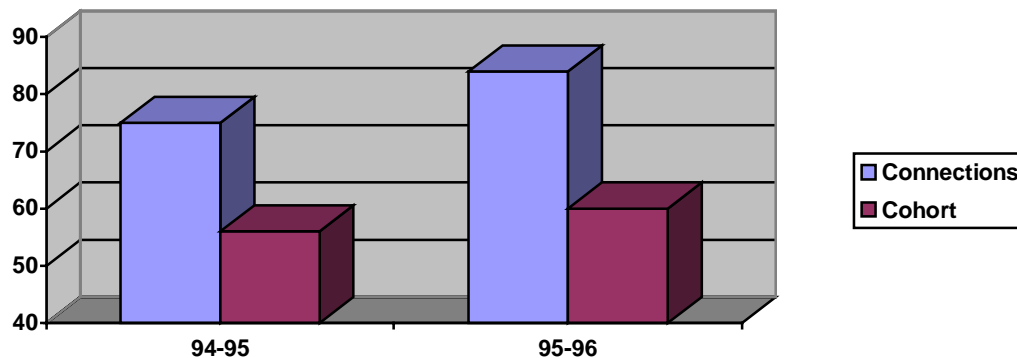


Figure 1. Comparison of Five-Year Graduation Rates for *Connections* students and CSM cohort

students entering CSM). For the CSM cohort entering in fall 1994, 56 percent graduated in five years compared to 75 percent for the *Connections* group; for the cohort entering in fall 1995, 60 percent graduated in five years compared to 84 percent for the *Connections* group.

For the group of *Connections* students entering CSM in 1994, 25 percent of both men and women graduated in four years (compared to 23 percent of the men and 30 percent of the women in the cohort). After five years, 72 percent of the *Connections* men and 81 percent of the women had graduated, compared to 55 percent of the men and 59 percent of the women in the cohort. These results are summarized in Figure 2.

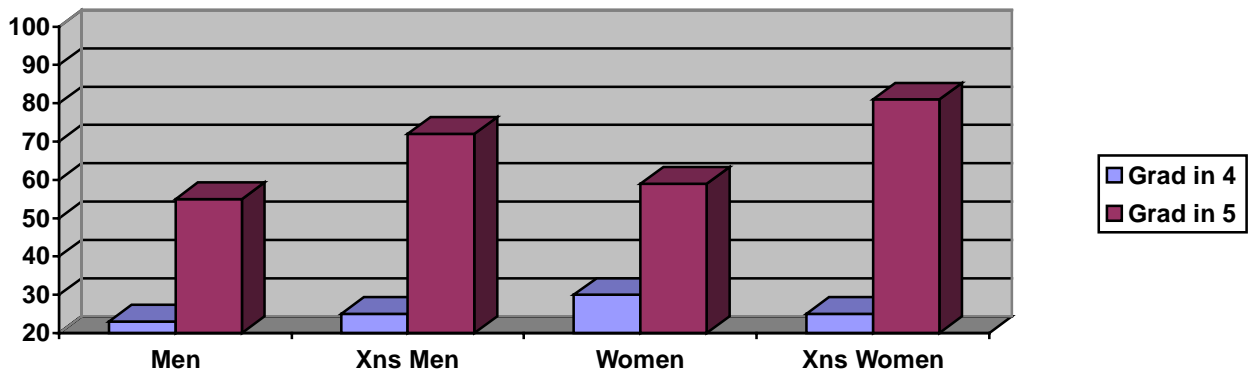


Figure 2. Comparison of Graduation Rates for 1994 *Connections* Group Compared to Cohort by Gender

For the group of *Connections* students entering CSM in 1995, 38 percent of the men and 60 percent of the women graduated in four years compared to 28 percent of the men and 35 percent of the women in the cohort. In five years 81 percent of the men and 90 percent of the women in the *Connections* group graduated, compared to 59 percent of the men and 64 percent of the women in the cohort. These results are summarized in Figure 3.

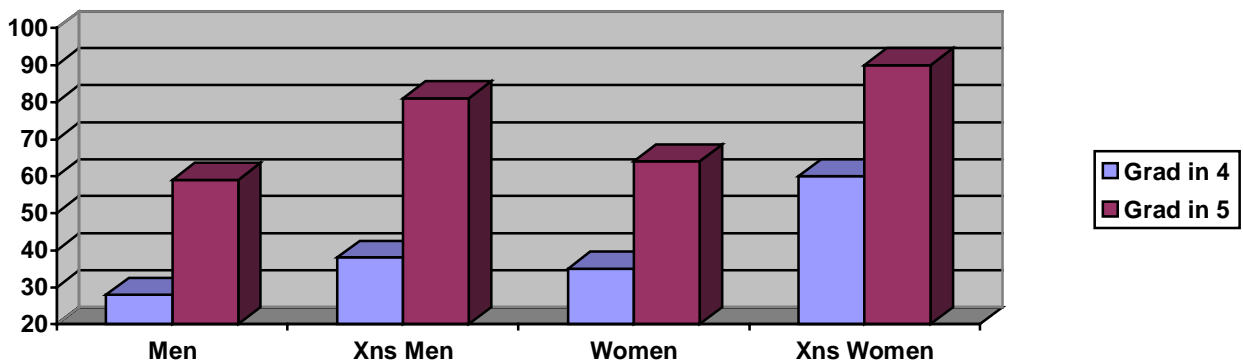


Figure 3. Comparison of Graduation Rates for 1995 *Connections* Group Compared to Cohort by Gender

In selecting the *Connections* students, we decided to recruit “average” CSM students because we wanted our program to be an enrichment program for typical CSM students, not for those entering with academic deficiencies or for those with advanced placement. Therefore, we extended an invitation to join the program to all incoming students who would be enrolled in the normal core curriculum and then selected the participants randomly from those who indicated an interest in the program. As Table 1 indicates, the incoming SAT and ACT scores of *Connections* students are similar to those of incoming students in their cohort, though the SAT scores for *Connections* students are slightly higher.

Table 1. Comparison of *Connections* and CSM Cohort SAT and ACT scores

<b>Score Averages</b>	<b>SAT</b>	<b>ACT</b>
<i>Connections</i> 4 year grads (entering 1994)	1226	28
<i>Connections</i> 5 year grads (entering 1994)	1264	28
CSM cohort (entering 1994)	1200	28
Non-graduates (entering 1994)	1206	27
<i>Connections</i> 4 year grads (entering 1995)	1226	27
<i>Connections</i> 5 year grads (entering 1995)	1259	29
CSM cohort (entering 1995)	1200	28
Non-graduate (entering 1995)	1147	27

Finally, we also compared the overall GPAs of the *Connections* group with the CSM cohort and found that the 3.28 GPA for the *Connections* students who entered in 1994 and graduated in four years was slightly lower than the 3.38 GPA for the CSM cohort and the 3.00 GPA of *Connections* students who graduated in 5 years was slightly above the 2.92 GPA for the cohort. A 3.32 GPA in four years for the 1995 *Connections* group was slightly lower than the CSM average of 3.41 and a 3.24 GPA for *Connections* students in five years was somewhat higher than the cohort’s 3.03 GPA. None of the differences was considered significant.

In summary, a comparison of the *Connections* students with their cohort at CSM allows us to reach several conclusions:

1. The students in the *Connections* program graduated at a significantly higher rate than the school average.
2. The *Connections* students did not have significantly higher test scores when entering CSM or significantly higher GPAs when graduating than the other students in their entering class.

Therefore, our conclusion is that the *Connections* program itself was at least partially responsible for the large increase in persistence of *Connections* students at CSM. In order to test this hypothesis, in the fall of 2000, we sent a letter asking participants in the program to complete a questionnaire about their experience in the program.

## The Questionnaire

The questionnaire asked students to respond to a series of statements related to both the content and mentoring/learning community goals of the program. Of the surveys that were deliverable from the class entering in 1994, 60 percent were completed and returned (49 percent overall). Of the surveys from the class entering in 1995 that were deliverable, 64 percent were completed and returned (58 percent overall). We consider these return rates above average for surveys of this type and no follow-up contact was made to obtain additional survey data. The responses from both groups about both program content and mentoring/learning community were overwhelmingly positive, but the questions related to mentoring/learning community were especially enthusiastic.

Students were asked to respond on a Lickert scale from 1 (not at all) to 5 (to a great extent) to ten questions about the program. The results of the survey from the 1994 group are summarized in Table 2 and the results from the 1995 group are summarized in Table 3. In reporting the results, we have pooled “1” and “2” responses in the first column, placed “3” responses in the second column, and pooled “4” and “5” responses in the third column. The first six questions deal primarily with the content goals of the program while the last four focus on the mentoring/learning community goals.

Table 2. Survey responses from *Connections* class entering in 1994 (in percentages)

Question	“Not at all” or “A little”	Neutral	“To some extent” or “To a great extent”
<i>Connections</i> helped me discover and develop significant <i>Connections</i> among my first year core subjects.	26.1	26.1	48.8
<i>Connections</i> helped me to enhance my critical thinking abilities and apply them in a variety of contexts.	16.7	16.7	66.6
<i>Connections</i> helped me to understand the historical and cultural contexts which have influenced developments in science, humanities, and engineering.	4.2	37.5	58.3
<i>Connections</i> helped me to become aware of and think about important historical and contemporary issues and ideas.	8.4	29.2	62.5
<i>Connections</i> helped me to further develop my sense of ethics and values, particularly about technology in the modern world.	20.8	16.7	62.5
<i>Connections</i> helped me to improve my oral and written communication skills.	8.2	12.5	79.2
I spent time outside of class socializing with members of my <i>Connections</i> group.	12.5	4.2	83.3
I spent time outside of class learning with members of my <i>Connections</i> group.	16.6	8.3	75.0
The quality of my learning at CSM was enhanced by my interactions with the other <i>Connections</i> students.	12.5	8.3	79.1
The quality of my learning at CSM was enhanced by my interactions with the <i>Connections</i> faculty.	12.5	4.2	83.3

Table 3. Survey responses from *Connections* class entering in 1995 (in percentages)

Question	“Not at all” or “A little”	Neutral	“To some extent” or “To a great extent”
<i>Connections</i> helped me discover and develop significant <i>Connections</i> among my first year core subjects.	16.7	5.6	77.8
<i>Connections</i> helped me to enhance my critical thinking abilities and apply them in a variety of contexts.	5.6	22.2	72.2
<i>Connections</i> helped me to understand the historical and cultural contexts which have influenced developments in science, humanities, and engineering.	5.6	11.1	83.3
<i>Connections</i> helped me to become aware of and think about important historical and contemporary issues and ideas.	12.6	18.8	58.8
<i>Connections</i> helped me to further develop my sense of ethics and values, particularly about technology in the modern world.	22.3	16.7	61.1
<i>Connections</i> helped me to improve my oral and written communication skills.	11.2	16.7	72.2
I spent time outside of class socializing with members of my <i>Connections</i> group.	5.6	5.6	88.9
I spent time outside of class learning with members of my <i>Connections</i> group.	5.6	11.1	83.4
The quality of my learning at CSM was enhanced by my interactions with the other <i>Connections</i> students.	0.0	11.1	88.9
The quality of my learning at CSM was enhanced by my interactions with the <i>Connections</i> faculty.	0.0	0.0	100.0

Although, as our formal objectives for the *Connections* program reveal, our initial focus in the program was on helping students to integrate their academic experiences, we quickly learned with the first pilot group that social and mentoring opportunities were more important to the students than the academic connections we worked so hard to forge. In the second iteration we focused much more on the learning community aspects of the program. The survey results from both groups indicate a higher level of agreement with the mentoring/learning community statements, though nearly all of the responses are heavily weighted to the positive.

Tinto enumerates four outcomes associated with learning communities he studied, all of which are borne out in our study: 1) students in learning communities “tended to form their own self-supporting groups, which extended beyond the classroom”; 2) “learning community students became more actively involved in classroom learning than other students, even after class....They tended to learn and make friends at the same time”; 3) “participation in the learning community seemed to enhance the quality of student learning”; 4) learning community students “persisted at a substantially higher rate than did comparative students in the traditional curriculum<sup>5</sup>.”

## Implications for Engineering Education

Based on the impact of the *Connections* program on our students and their feedback via the longitudinal survey, we believe that:

1. Mentoring makes a difference. The students felt that interactions with faculty were the single most positive aspect of their *Connections* experience.
2. Learning communities are important. Students who feel that they belong from the beginning are more likely to persist, even if the intervention terminates.
3. Content of integrated programs, while important, does not have the impact that personal contact has. Faculty should think carefully about designing first-year programs. We learned that our expectations and our students' expectations didn't necessarily match.
4. Resources spent up front to allow top faculty to teach and mentor first year students pay dividends in increased retention and overall satisfaction with the educational experience.

## Acknowledgement

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