LESSONS LEARNED IN ESTABLISHING STEM STUDENT COHORTS AT A BORDER UNIVERSITY AND THE EFFECT ON STUDENT RETENTION AND SUCCESS

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Abstract

The University of Texas at Brownsville (UTB) serves more than 8,000 students in the Lower Rio Grande Valley area and broader Mexico region. UTB is a Hispanic-serving institution that attracts students from the surrounding areas, including the Mexico border region. The College of Science, Mathematics and Technology (CSMT) established a Science, Technology, Engineering, and Mathematics (STEM) cohort program to help the majority of students to earn a degree in a STEM field in the shortest possible time. The challenges and obstacles encountered during the planning and implementation phase of the STEM cohort program are discussed in this paper, as are the adjustments and real solutions adopted to move the project forward and the retention problems encountered with the student groups.

Introduction

Bureau of Labor Statistics projections of employment in 2014 suggest that apart from IT-related occupations, most other scientific, technological, engineering, and mathematical (STEM) professions are expected to grow moderately, at rates similar to those for the entire U.S. labor force. One of the largest increases in college enrollment is expected to come from the Hispanic population, which is not only the largest minority group in the U.S., followed by Blacks, but also the fastest-growing minority group [1,2]. However, this group is consistently underrepresented in the STEM workforce. Therefore, there is an urgent need for members of this minority group to successfully complete postsecondary education in the STEM-related fields.

The University of Texas at Brownsville , situated in the border region of Mexico, is a Hispanic-serving institution (91% Hispanic, 96% U.S. citizens) that is located in one of the poorest areas of the country, Cameron County. The The University of Texas at Brownsville is a commuter campus; most of the students have to work full-time. The problem of Hispanic underrepresentation is exacerbated when students of this minority drop out of STEM education programs for various reasons, such as inadequate math and science preparation at the high schools, lack of mentors at home, inadequate peer support, etc. In order to address the preparation and college adaptation gaps within this student group, the College of Science, Mathematics and Technology at UTB implemented a cohort program for STEM majors. The details of this cohort program, and its successes and challenges, are discussed in the subsequent sections.

Significance of Project and Rationale

At UTB it is very difficult for students to complete their education and obtain a bachelor's degree in a 4-year term. The majority of students are the first generation in the family to attend college; they do not see the need for higher education and cannot see the possibilities provided by it. Students do not get enough academic support in the family, and they do not have an adequate framework for higher education. These students fail many courses in the first year, resulting in a

lower GPA and subsequently the need to repeat these courses. The STEM cohort program at UTB helps students to work together as a team to achieve their academic objective of majoring in a STEM discipline with minimum disruptions (3,4,5).

Cohort Definition

A cohort is a group of students who follow the same class schedule and progress together through an accelerated program until degree attainment. The unique scheduling, along with small class sizes, promotes an interactive learning environment, facilitates networking opportunities, strengthens student relationships, and enhances the student learning experience (6,7,8).

In Year One the initial cohort grouped, by program, 83 first- and second-year students majoring in chemistry, biology, mathematics, or engineering. The cohort-building process comprised both the establishment of productive academic relationships among students, and the development of students' affinity toward the college and its programs.

The STEM cohort program has attractive benefits to students, including successful completion of science and math courses. The essential elements of this program are:

- course sequencing to foster a peer support network and team building
- mentoring of new STEM majors
- programmed tutoring
- program-specific academic support services
- community building and collaborating opportunities
- improved retention.

The goals of the STEM cohort program at UTB are given below:

Goal 1: To show a clearly-defined path toward timely graduation. The cohort program helps the students by grouping courses in such a way as to facilitate timely graduation.
Goal 2: To help students to make the right choice of classes for every semester of study. Course schedules are established. Cohort students do not need to worry about finding needed classes.
Goal 3: To develop a strong peer support system. In the program, students are encouraged to work together in a group of peers with the same majors, interests, and focuses in a fun-filled learning environment.
Goal 4: To use the limited available resources to develop a mentoring and tutoring support system.

Successful Implementation of the Cohort Program

The cohort program was meticulously implemented during the Fall 2012 semester. It was our expectation that the successful implementation of this program would result in increased GPAs and higher retention rates among the students in the cohort. Each student entering the university with a declared STEM major received a series of electronic communications from the cohort team explaining the cohort and its positive benefits. Presentations were made at each mandatory new student orientation with opportunities for the new STEM major to obtain clarification of the program.

In the Fall 2012 semester, students were encouraged to apply to the initial cohort program in order to improve their academic success through unique tutoring and mentoring sessions. The pilot CSMT cohort program grouped entering students into their STEM major-required courses within one of four majors: chemistry, mathematics, biology, and engineering. In the first semester, 28 applications were accepted to engineering and 32 applications were accepted to biology; the other two targeted majors did not have sufficient student applications to warrant establishing a cohort. The lowest criterion for acceptance to the cohort was the level of mathematics preparedness: students were required to take at least Pre-calculus in their first semester of college.

The two cohorts (biology and engineering) were further subdivided into one of two mathematical components, resulting in a total of four subcohorts. Biology cohorts contained a block of Chemistry-1 with laboratory, Biology-1 with laboratory, and Mathematics (either Pre-calculus or Calculus-1) courses. Engineering cohorts had a block with Chemistry-1 with laboratory, Introduction to Engineering, and Mathematics (either Pre-calculus or Calculus-1). Students could also choose elective courses; typically these electives included English, Speech, History, Government, Art, or Music Appreciation, depending on prior high school courses taken.

In the Spring 2013 semester, the number of participants in the cohort increased to 83. As in the previous Fall semester, the biology and engineering cohorts were subdivided into components based upon mathematics, chemistry, biology, or physics course requirements.

At the conclusion of the first year of cohorting, the 83 participating students completed their courses with an overall 3.02 grade point average. Of that number, 77 of the students enrolled for the Fall 2013 semester for a retention rate of 92.8%.

Cohort support services and programs included:

- student meetings
- professional services and seminars
- mentoring networks
- cohort mentors
- development of skills
- sharing of resources.

Challenges and Obstacles Encountered During Planning and Implementation

One of the main challenges for the cohort program was the variation in levels of high school education and college preparedness. One solution was provided by the Mathematics Department, which gave the students the opportunity to attend summer workshops and to be tested out of College Algebra and Pre-calculus. Even though College Algebra is not a prerequisite for Pre-calculus, it is still a prerequisite for Chemistry-1 and some other courses.

Another problem was students' lack of desire to make contact with mentors and program coordinators during the semester. Temporarily, this problem was solved by UNIV sections and by allowing lecturers to give all announcements and surveys during class time. For Year Three

(Fall 2014 – Spring 2015) of the program, mandatory tutoring will be added to select math courses; we hope to determine whether this will be a greater motivator for student participation.

The most significant challenge to sustaining the cohort program came in the Fall 2013 semester when a shortage of classroom and laboratory space made it impossible to block classes. Restricting cohort participants to specific class sections had greatly facilitated the success of the first year of the program; however, in the absence of that option, we were required to implement a modified approach in the Fall 2013 semester. The junior and senior STEM majors who had been mentors for Year One of the program maintained their same assigned mentees for the new academic year. If a mentor had graduated, the cohort student was assigned a new mentor in the same major field of study. For the Spring 2014 semester, the program was able to restrict enrollment into class sections for calculus. Because most of the STEM degrees require calculus, the project team has been able to place biology and engineering majors into cohorted class sections.

This approach will also address another problem encountered in Year One. Every declared STEM major admitted for the Fall 2012 semester received multiple communications informing them of the program; only 60 students applied. Now, by arbitrarily placing STEM students into major-specific calculus classes, a cohort is naturally formed. Each student is assigned a mentor, and activities are held to foster the sense of shared experience with the expectation that the STEM cohort will grow as a result.

Another important lesson learned going into Year Two was the importance of effectively using social media and electronic communications to contact the students. Although each student is assigned a university email address, it became evident the students only rarely check it for messages. Therefore a concerted effort has been made to solicit the students' primary personal email addresses. This has improved communication.

Overall Academic Performance of Cohort Students

The overall academic performance of cohort students showed a significant increase. The starting average GPA of the cohort students was 2.50. The end of the semester GPA result is shown in Table 1. It can be seen that there was a significant increase of GPA across all the cohorts, with the exception of the biology cohort with pre-calculus.

Table 1. GPA results for first-year cohort program.

	Biology cohort w/calculus	**Biology cohort w/pre-calculus**	**Engineering cohort w/calculus**	**Engineering cohort w/pre-calculus**
Average GPA	2.8	2.07	2.67	2.37
Highest GPA	3.93	3.38	3.71	2.96
Lowest GPA	1.02	0.58	1.11	1.41

Cohort Performance in Mathematics

The biology cohort got an average of C+ for Pre-calculus and B+ for Calculus-1. The average grade for the engineering cohort was C+ for Pre-calculus and C for Calculus-1.

Cohort Performance in Chemistry

The biology cohort got an average grade of B- for Chemistry-1 with laboratory. The average grade for the engineering cohort was C+ for Chemistry-1 with laboratory.

Underutilization of Tutoring Services

The tutoring system provided by cohort program was not as effective as had been anticipated; most of the students declared that they would only attend mandatory tutoring sessions. While nearly all students attended mathematics (Pre-calculus and Calculus-1) tutoring, relatively few attended other sessions. When looking only at math tutoring sessions, it became apparent that those for Calculus-1 were more frequently attended (and professors were more often visited during office hours) than were those for Pre-calculus.

Assessment and Evaluation

In the Fall 2012 semester, the pilot CSMT cohort program was initiated by grouping first-time freshmen according to major, with the goal of improving students' academic success through unique tutoring and mentoring sessions. The cohort program was offered in four majors: chemistry, mathematics, biology, and engineering. The criteria used to admit the students in the cohort program are based on mathematics preparedness. The cohort students should at least be eligible to register in Pre-calculus in their first semester of college.

The The University of Texas at Brownsville maintains an "open door" admissions policy, based on high school curriculum, high school rank, and scores on the SAT or ACT. However, some of the partner community college programs and undergraduate programs have specific admission requirements. Historically, the incoming freshmen admitted to the STEM majors exhibited common characteristics such as not being calculus-ready. These general characteristics of the incoming freshmen are captured through a survey instrument. The data collected from the survey are used as a benchmark and comparison tool to assess the efficacy of the cohort program in the subsequent semesters.

The following survey instruments were developed based on the objectives of the cohort:

a) Student demographic survey instrument, used to collect the background details of the incoming freshmen registered in the STEM courses.
b) Cohort experience survey instrument, used to collect the students' experiences and their goals

The survey instruments, included in the appendix, are distributed to the students in the first year, University seminar (UNIV) sections blocked in the CSMT cohort program. Also, the survey

instruments are distributed to these students through emails. The timing of the survey is planned in such a way that the students can reflect on their experiences with the cohort program.

It may be mentioned at this point that this survey is intended to get the students' feedback on the cohort program and their backgrounds. As such, survey responses are used to find out the general characteristics and background of the students that have registered in the STEM courses and their experiences with the cohort program.

Survey Findings

The questions in the survey instruments for students are divided into two categories:

Category 1: Questions related to identify the gender, region, number of graduates in the family.
Category 2: Questions related to the reason to attend college, intended major, status of employment, and their experience with the cohort program.

The efficacy of the cohort program was assessed by the feedback collected from the students through surveys (9,10,11). The survey questionnaires were distributed in UNIV sections of the CSMT cohort program and the data were analyzed. A total of 60 responses were received.

In the engineering department most of the cohort students (26 of 28) were males; within the biology major the proportions of males and females were identical. The vast majority of students from both cohorts were from the ages of 18 to 20.

Thirty-three percent of cohort students from the engineering major declared themselves to be first-generation college attendees. Exactly 50% of them declared their major as physical mechanics; the other 50% were declared electrical engineering, bio-engineering, or engineering technology (ET) majors.

Most of the students admitted to the biology cohort (81%) were first-generation college attendees. Almost all of them declared their major as connected to the medical field (future pre-med department, bio-med department, or nursing).

Among nearly all students, the stated reason for attending the university was "financial reasons" or "to have a better job"; only two answered "because I like to study" or "to make my family/parents proud". At the same time, only 12% of cohort students were working at least part-time.

Student Feedback

When asked about the CSMT cohort program, all students responded that this system had made their student life much more organized; it had also become much easier due to extra advising services, a simplified registration process, and guaranteed seats in cohort courses. The student survey results shown in Table 2 provide an indication that the cohort program generally helped the students to achieve academic success.

Table 2: Student self-ratings of preparation for STEM subjects (1-10 ratings)

Course	Pre-Survey	Mid-Year Survey	End-of Year Survey
Math	6	7	9
Chemistry	5	7	8
Engineering	5	7	9
ET	7	8	9

Conclusion

The UTB-CSMT cohort program initially grouped 60 first- and second-year STEM students by major in order to improve their academic success through unique tutoring and mentoring sessions. In Fall 2012, the program was offered to students majoring in chemistry, biology, mathematics and engineering. According to the exit survey, the students in general acknowledged the benefit of the cohort program. Most students in the cohort showed improvement in GPA. The cohort program achieved its main intended result of retaining the students in the following semester. At the end of the fall semester, fully 100% of cohort students were registered to take cohort courses in the Spring 2013 semester, along with an additional 23 new cohort members. Of the 83 students participating in Year One of the program, all but six returned for the 2014 academic year. Year One cohort students achieved an average overall GPA of 3.02. Among students who participated in Year One, the cohort proved to be beneficial in assisting them to have academic success and the confidence to return for the next academic year. The CSMT cohort program is continuing its operation to serve the minority students and to help them succeed in the STEM fields.

Though some of the challenges were generic in nature, others were specifically associated with the socioeconomic environment of the region from which UTB draws much of its student body (12,13,14,15). All of our findings are potentially applicable to other minority-serving institutions. Discussions are provided in the lessons learned and the student feedback that resulted in changes to subsequent offerings of the program. The paper includes data on cohort student academic progress and results of a survey conducted to assess the efficacy of the cohort program.

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Appendix:

Student Demographic Sheet

Thank you for printing and filling out your demographic information. Please check the most appropriate answer to each question and answer all the questions. ****Do not forget to attach this sheet to your submission!****

Gender:
❒ Male
❒ Female

Age: _____

Grade Level:
❒ 9th grade
❒ 10th grade
❒ 11th grade
❒ 12th grade

Are you bussed into this school?
❒ Yes, from where_____
❒ No

Do you qualify for the reduced lunch program?
❒ Yes
❒ No
❒ I don't know

What is the highest academic degree you expect to earn?
❒ High School or GED
❒ Bachelor of Arts or Science
❒ Master of Arts, Master of Science, or other master's
❒ MBA
❒ J.D (Law)
❒ M.D. (Medicine)
❒ Ph.D. or Ed.D.
❒ Other: _____

My high school GPA is:
❒ Less than 1.0 (D and below)
❒ Between 1.0 and 2.0 (D to C)
❒ Between 2.0 and 3.0 (C to B)
❒ Between 3.0 and 4.0 (B to A)
❒ 4.0 and above (from UC- courses)

What is your race / ethnicity? (check one)
❒ Central-American
❒ Cuban-American
❒ Mexican-American/Chicano
❒ Puerto Rican-American
❒ South-American
❒ Other Latino_____
❒ African American
❒ Asian American or Pacific Islander
❒ Caucasian
❒ Native American
❒ Multiracial _____
❒ Other_____

I am enrolled in: (check all that apply)
❒ AP classes/Honors classes
❒ Technical/Vocational classes
❒ A-G required classes
❒ Work Co-op program
❒ Community College courses
❒ ACT/SAT prep course

Do you work outside of school? (check all that apply)
❒ No
❒ Work for family
❒ Work part-time
❒ Work full-time

I plan to take:
❒ ACT
❒ SAT I
❒ SAT II
❒ None

Have you been continuously enrolled in high school since you began? YES NO

If no, how many semesters did you stop out of school? _____ semesters

What is your mother's highest completed level of education?
❒ No formal education
❒ Elementary (1-5)
❒ Middle school
❒ Some high school
❒ High School (9-12)
❒ Some college (no degree)
❒ BA/BS
❒ MA/MS/MBA
❒ Ph.D. or Ed.D.
❒ Professional (M.D. or J.D.)
❒ Other: _____
❒ I don't know

What is your father's highest completed level of education?
❒ No formal education
❒ Elementary (1-5)
❒ Middle School
❒ Some High School
❒ High School (9-12)
❒ Some College (no degree)
❒ BA/BS
❒ MA/MS/MBA
❒ Ph.D. or Ed.D.
❒ Professional
❒ Other: _____
❒ I don't know

Do you have any siblings? YES NO

Have any of your siblings attended college? __

If yes, have they completed a college degree? _____

If yes, have they given you advice about education? ____

If no, are they currently enrolled in college? _____

Do your parents give you advice about education? YES NO

What is your family income?

❒ Less than $10,000
❒ $10,000-$19,000
❒ $20,000-$29,000
❒ $30,000-$39,000
❒ $40,000-$49,000
❒ $50,000-$59,000
❒ $60,000-$69,000
❒ 70,000 & Above

Who of the following family members were first to be born in the United States?

❒ No one in your family
❒ Yourself or your siblings
❒ Your parents
❒ Your grandparents
❒ Your great-grandparents

If no one, how long have you been in the US? _____

I value the degree that I am currently working toward

❒ Strongly Disagree
❒ Disagree
❒ Strongly Agree
❒ Agree

Organize your story around the following questions:

College Pursuit:

1. Why did you choose to attend college?

2. Who and/or what influenced or motivated you to attend college?

3. Who and/or what helped you get to college?

4. What challenges/concerns did you overcome in order to attend college?

College Experience:

5. Describe your college experience

6. How would you describe the campus climate or what's known as the campus environment at your university?

7. What's it like to be a Latina/o undergraduate at your university?

8. What do you do to cope with the university environment?

   a. What do you do to retain yourself in the system?

   b. What personal strengths/skills were important in achieving your goals?

9. What resources did you use to assist you in continuing your degree?

10. What have you done to attain mentorship?

11. What on-campus social supports do you have in place to help you succeed academically?

12. What off-campus social supports do you have in place to help you succeed academically?

13. What values do you think the university most rewards?

14. How do you manage the fit between your cultural values and those of the university?

Future Benefits:

15. In what way(s) do you think your degree with help you in the future?

16. What are your plans for the future?

Recommendations:

17. What advice would you give high school students who are thinking about pursuing a college education?

18. What do you recommend for the university to do to best support you and your educational goals?