

AC 2009-926: SUMMER TRANSITION PROGRAM: A MODEL FOR IMPACTING FIRST-YEAR RETENTION RATES FOR UNDERREPRESENTED GROUPS

Ruba Alkhasawneh, Virginia Commonwealth University

Ruba A. Alkhasawneh is a Ph.D. student in engineering at Virginia Commonwealth University. She received her B.S. and M.S. degrees in Computer Engineering from Jordan University of Science and Technology and Yarmouk University, respectively in Jordan. Her research focuses on diversity issues and engineering education.

Address: 601 West Main Street, PO Box 843068, Richmond, VA 23284-3068; e-mail: alkhasawnera@vcu.edu.

Rosalyn Hobson, Virginia Commonwealth University

Dr. Rosalyn S. Hobson is the Associate Dean for Graduate Studies and Associate Professor of Electrical Engineering at Virginia Commonwealth University in Richmond, Virginia. She received her B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Virginia. Her current research interests include artificial neural networks and their application to systems modeling, signal processing, manufacturing, and controls engineering. She has worked extensively in K-12 science, technology, engineering and math non-formal and formal education. She currently serves on the REACH and the Richmond Area Program for Minorities in Engineering Boards of Directors. She also has worked with the National Science Foundation, the Department of State, the Department of Education, and the American Association for the Advancement of Science (AAAS) fostering collaborations, between these organizations which promote science, technology, engineering, and math educational activities in developing countries.

Address: 601 West Main Street, PO Box 843068, Richmond, VA 23284-3068; e-mail: rhobson@vcu.edu.

Summer Transition Program: A model for impacting first year retention rates for underrepresented groups

Abstract:

In order to ensure first year academic success for underrepresented minorities (African American, Hispanic American, and Native American) and increase diversity in science, technology, engineering, and mathematics (STEM) disciplines, VCU offered its first Summer Transition program (STP) in summer 2008. The VCU Summer Transition Program was funded by a National Science Foundation (NSF) as a part of the Virginia North Carolina Louis Stokes Alliance for Minority Participation (VA-NC LSAMP).

STP was a residential four week program for entering freshmen targeting fourteen STEM majors including engineering, natural sciences, and mathematical sciences. The program focused on developing essential skills such as communication skills and critical thinking; enhancing mathematics and science study skills; and transition smoothly to the university community. This was a rigorous pre-college preparation program, which included; three classes (six credit hours), drop-in tutoring, summer research experiences, field trips, and guest speakers. A four hundred and fifty dollar stipend was awarded to each participant.

I. Introduction:

The lack of students in science, engineering, and technology is a major concern in many developed and developing nations [1]. A recent study by May and Chubin [2] showed that the United States plays a leading role in the development of research in science, technology, engineering, and mathematics (STEM). However, in order for the nation to remain internationally competitive it is necessary for the US to continue to produce a qualified workforce in these fields. Since the population of non-Hispanic white males of the working age will decline 11% in the period between 1995 and 2050, it is necessary to focus on increasing diversity in STEM disciplines [2]. May and Chubin also reported that underrepresented minority students' performance in science, mathematics, and engineering is less than white and Asian students' performance in these fields [2]. Tan [3] claimed that "Although it is true that freshman STEM majors have indeed grown in numbers in the last decade or so, women and ethnic minorities (with the exception of Asian Americans) are still underrepresented in STEM disciplines. Compounding the problem are the lower persistence and graduation rates among underrepresented minorities and women".

First year academic success programs play an effective role in improving retention and graduation rates for underrepresented minority students in science and engineering fields. Literature described that first and second semester grades were strong predictors for students' retention in engineering majors [4]. Reason [5] reported that first year college GPA, for both minority and non-minority groups, is the main factor that affects student's retention. Some studies stated that minority students have higher attrition rate [5-7]. Retention rate for underrepresented minority students in science and engineering is approximately 33.3% compared to 66.6% for non-minority groups [8]. Pre-college programs such as summer transition programs

have been shown to be effective ways to improve retention rates for minority students and support them to achieve academic success [2], [7].

Virginia Commonwealth University (VCU) statistics for fall 2007 showed that the overall population of minority students at VCU represents 25%, While 22% participants in STEM majors are minorities. In the fall of 2008, the freshmen minority enrollment in STEM majors was 20.16% of the total enrollment. In order to ensure student's first year academic success and increase diversity in STEM fields, VCU offered its first Summer Transition program (STP) in summer 2008. Twenty two incoming freshmen were chosen to participate based upon major, high school GPA, and math placement test score. The following majors were represented: engineering (59.1%), biology (27.3%), and forensic science (13.6%). Females represented 50% of the overall population of the program, 36% of them were majoring in engineering. Moreover, we observed that around 50% of the accepted students, for fall 2008, in STEM majors at VCU were females, which is a good indicator for women participation in STEM fields.

Program services and activities:

The first Summer Transition Program (STP) played a valuable role in the academic development and preparation for twenty two incoming freshmen majoring in science and engineering. The residential four week program included a set of activities such as academic courses, drop-in tutoring, summer research experience, guest speakers, and trips.

Most of freshmen engineering students do not perform well in their first mathematics class [9]. In response to this statistics, the STP included pre-calculus, MATH 151, in its curriculum to help participants overcome difficulties students face during their first required mathematics class, calculus. The students were administrated the math-placement which was a prerequisite for the program participation. Sixteen students were qualified to take pre-calculus class, four students were qualified for calculus (MATH 200) class, and two were qualified for algebra (MATH 131/141). Students who placed into calculus chose to attend the STP pre-calculus as a refresher class. Conversely, the two students who placed into algebra still chose to attend with their peers to enhance their mathematical skills before the fall semester starts. However, they did not take the class for credit.

The Study Skills class was essential series of lectures to prepare students for college life, enhance their study habits, and improve their communication skills. Students also had the chance to share their views and skills through participation in the class room. Since all participants were majoring in science and engineering, a special topics science and engineering laboratory was established which was geared toward developing students' laboratory reports writing skills. Drop-in tutoring helped students to overcome the difficulties they faced in the math class and assist them to understand the material better than before. This portion of the program was optional and only 22.7 percent of participated students attended the tutoring.

Kardash [10] described that the involvement of undergraduate students' in research as a significant instructional tool. The STP responded to this finding by involving students in undergraduate research with mentors they chose based upon research interests. The students were asked to search the VCU website for faculty with whom they were interested in working.

They then had to compose an e-mail requesting an opportunity to work in the faculty mentor's laboratory. eight out of twenty two students were successful in securing a research opportunity in a laboratory. Students worked as researcher assistants in laboratories on a variety of projects, such as stem cells, speech recognition, and tissue regeneration. The goal was to expand their knowledge in the research fields in their departments and train students on professional communication.

During the program three guest speakers were invited, experienced scientists and engineers, to talk about their career experience and the variety of opportunities for students once they are graduated. The guests were; Dr. Charlene Crawley, a chemistry professor at VCU; Mr. Tony Moss, a mathematician at Dahlgren NSWC; and Ms. Nekole Varnado, an electrical engineer and the president and CEO of IT Egnuity Inc. Students also participated in two educational field trips to Dominion Virginia Power and VCU Inger and Walter Rice Center for Environmental Life Sciences.

Two surveys were administered to all participants during the program at the end of the second and the fourth week. The purpose of these surveys was to measure each student's development to predict the students' academic success in the upcoming year. In reviewing student's response and comments it is believed that building a supportive environment for underrepresented minority students and fostering the relationship between them and faculty members are essential for students to achieve academic success, which leads to higher retention rates.

II. Methodology and Results:

The total population of VCU freshmen in STEM majors for the fall 2008 semester was 944. The STEM majors represented were biology, physics, all mathematics disciplines, chemistry, forensic science, computer science, all engineering disciplines, bioinformatics, and environmental studies. In order to understand the impact of the STP program on students' performance, two groups are compared in this paper, STP participants and non-STP participants. The two groups matching criteria were race/ethnicity, major, and high school GPA. Compared variables in this paper are overall GPA (fall 2008), and students' math grades. The summary of the demographics of the two groups are represented in table 1. The statistical methods used in this evaluation were the equal variance t-test. In addition, the software used in this study to conduct the statistical analysis was JMP version 7.0.

Table 1
Summary of study the two groups

Characteristic	STP minority students	Non-STP minority students
Race/Ethnicity (%)		
African American	90.9%	77.3%
Hispanic American	9.1%	18.2%
American Indian	0%	4.5%
Gender(%)		
Male	50%	50%
Female	50%	50%
Mean High School GPA	3.6	3.96

Two surveys were administrated during the program to participants. Survey data were collected at the end of the second and the fourth week. The first questionnaire consisted of seven questions. The items asked about students' courses, instructors, program, and self evaluation. The second questionnaire focused on students' self evaluation and program evaluation. Both questionnaires were designed to be answered within ten minutes.

In reviewing surveys it was observed that students who had good mathematical high school skills had better grades in mathematical courses compared to their peers who had poor mathematical skills. These students with good mathematical skills tend to invest their old study habits and the new habits they learned in the STP study skills course for their exam preparation. In addition, they were enthusiastic and looking for improvement to get better and be well prepared for the upcoming semester. Moreover, students who used to study in groups did achieve higher grades in their exams compared to students who had "asking for help" as a last option if they fail to understand the material.

Students evaluated the Math 151 class as a challenging and effective class in increasing their knowledge in that area. However, it was less challenging for students who were placed in an upper math level or had good mathematics skills. From these surveys it can be revealed that the special topics in science and engineering class achieved its goal in preparing students for laboratory reports writing with hands-on experience. It also can be noticed that the study skills class affected positively students' study habits such as note taking; team work; communication skills by interacting during the class; and test preparation. For the instructor evaluation side, preparation, cooperation, and being organized were rated highly by students.

The summary results for cumulative GPA, for fall 2008, are shown in Table 2. Measurements were divided into two groups the STP participants group and the non-STP participants group. Using an equal variance t-test results show that there was no sufficient evidence from these data to provide that the cumulative GPA mean of STP participants group is different from the cumulative GPA mean of non-STP participants group. Referring to Table 1 and Table 2, it can be inferred that although the STP participants group mean high school GPA (3.6) is less than the mean high school GPA for the non-STP participants group(3.96), the mean for the cumulative GPA for fall 2008 was relatively close which is a good indicator for the program success.

Table 2
Cumulative GPA for fall 2008 for students in the two groups

Group	N	Cumulative GPA Rate	SE
STP Students	22	2.8	0.72
non-STP Students	22	2.7	0.70
Difference		0.01	0.79

*The average Cumulative GPA rate in both groups was not significantly different ($t = 0.06$, $df = 21$, $p\text{-value} = 0.9525$).

In this study, which used 20 STP participants in the Math 151 class, a proportion of 0.45(9 students) of subjects who had an A in the Math 151 course was observed. However, the second matched group, the non-STP participants group, only seven out of twenty two students took the Math 151 class during fall 2008. None of them earned an A, see table 3.

Table 3
Outcomes in the two groups for Math 151

Group	Outcome					
	A	B	C	Dropped	Average Performance	total
STP Students	9(45%)	6(30%)	5(25%)	None	3.2	20
non-STP Students	None	4(57.14%)	1(14.29%)	2(28.57%)	2.8	7
total						27

During the fall 2008 semester, only fifteen out of twenty two of the STP students registered for the calculus class. Of the remaining STP students, two placed into a higher math class, calculus II, two registered for Math 131/141 class, and three didn't register for a math class. The non-STP group had 3 students who registered for Math 200 class, eight registered for Math 131/141, one didn't register for math class, and three qualified for a higher math level.

For the Math 200 class, which had fifteen participants of the STP, we observed a proportion of 0.27 (4 students) of students had an A (see table 4). It can be revealed that the STP participants performed better in the Math 200 class. In addition, the STP participants had the chance to start with a higher math level after the pre-college program and they have earned more college credits compared to the non-STP participants group. We also noticed that the STP students worked harder to be placed into Math 151 or higher in order to be qualified for the program. Therefore, they have earned six college credits from the STP and another three credits by being placed into Math 151 instead of Math131/141.

Table 4
Outcomes in the two groups for Math 200

Group	Outcome					Average Performance	total
	A	B	C	D	F		
STP Students	4(26.67%)	3(20%)	3(20%)	4(26.67%)	1(6.67%)	2.33	15
non-STP Students	Non	1(33.33%)	2(66.67%)	Non	Non	2.33	3
total							18

III. Discussion:

This study focused on preparing students for college life to increase their retention rate. The summer transition program participants commented that they had a good taste of college life during the program. Additionally, they had a valuable dorms life experience so they will not feel isolated in the upcoming semester. They also improved several skills they need as engineering and science students such as writing and mathematical skills. The self-confidence of the participants also improved by being placed in a higher math level compared to their peers in the same major. The supportive environment during the summer program played an important role for students which encouraged to work hard and get higher grades.

Compared to the non-STP participants group, STP students were well prepared for the transition from high school to the new college life. They earned six additional credit hours; and their average performance in the math class was comparable to if not better than the non-STP students. STP students were well prepared for the laboratory work. They overcame the fear of laboratory reports writing and familiarized with the nature of laboratory work. In addition, they had the chance to work in research fields in which they are interested. This study was limited to a sample of twenty two students who participated in the summer transition program and another matched group of non-STP participants.

IV. Conclusion:

The STP was a rigorous pre-college preparation program for underrepresented minorities in STEM disciplines at VCU. The program was established in summer 2008 for incoming minority freshmen in STEM majors to increase their retention rates. A set of services and activities were offered to create a supportive environment for participants; developing their mathematics and science study skills; and enhancing students' communication skills.

It is expected that the summer transition program exposed its participants to a better understanding of college life and building up the supportive environment that students need. They will consider that they need to discuss the academic and social difficulties they face during the academic year with student's organizations and programs before dropping out their classes or ending up with a non-STEM major. For four weeks students were able to emulate the real college life; the summer classes, drop-in tutoring, being organized, and dorms experience played a key roll in participants' pre-college preparation.

The results from this study showed that such programs are necessary for underrepresented minorities to enhance their academic success. Furthermore, preparing them to be competitive and overcome their first year difficulties.

References:

- [1] Crawley, E., Malmqvist, J., Ostlund, S., and Brodeur, D., 2007. *Rethinking Engineering Education*. New York: Springer Science + Business Media, LLC.
- [2] May, G. S. & Chubin, D. E., 2003. A Retrospective on Undergraduate Engineering Success for Underrepresented Minority Students. *Journal of Engineering Education*.
- [3] Tan, D. L., 2002. Majors in Science, Technology, Engineering, and Mathematics: Gender and Ethnic Differences in Persistence and Graduation. Proceeding: 42nd Annual Association for Institutional Research (AIR) Forum, Toronto, Canada.
- [4] Mendez, G., Buskirk, T.D., Lohr, S., & Haag, S. 2008. Factors Associated with Persistence in Science and Engineering majors: An Exploratory Study Using Classification Trees and Random Forests. *Journal of Engineering Education*, Vol. 97, No. 1.
- [5] Reason, R. D., 2003. Student Variables that Predict Retention: Recent Research and New Developments, *NASPA Journal*, Vol. 40, No. 4.
- [6] Mitchell, T. L, & Daniel, A., 2007. A Year-Long Entry-Level College Course Sequence for Enhancing Engineering Student Success. Proceeding: *International Conference on Engineering Education*.
- [7] Persaud, A. & Freeman, A. L., 2005. Creating a Successful Model for Minority Student' Success in Engineering: The PREF Summer Bridge Program, Proceeding: *WEPAAN/NAMEPA Joint Conference*.
- [8] Hargrove, K. S. & Burge, L., 2002. Developing a Six Sigma Methodology for Improving Retention in Engineering Education, Proceeding: *ASEE/IEEE Frontiers in Education*, 32nd Conference, Boston, MA.
- [9] Reyes M. A., Anderson-Rowland, M. R., & McCartney, M. A., 1998. Freshman Introductory Engineering Seminar Course: Coupled with Bridge Program Equals Academic Success and Retention. *Frontiers in Education Conference*.
- [10] Kardash C. M., 2000. Evaluation of an Undergraduate Research Experience: Perception of Undergraduate Interns and Their Faculty Mentors, *Journal of Educational Psychology*, Vol. 92, No. 1, 191-201.