Ms. Ruba Alkhasawneh, Virginia Commonwealth University

Ruba Alkhasawneh earned her Ph.D. in engineering from Virginia Commonwealth University in 2011. She received her B.S. and M.S. in computer engineering from Jordan University of Science and Technology and Yarmouk University, respectively. Her research interests in the engineering education field focus on modeling first-year student academic success and retention in STEM disciplines. Also, she has interests in problem-based learning, increasing diversity in STEM fields, and evaluating engineering programs and activities which are designed to improve student learning outcomes.

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Identifying significant features that impact URM students academic success and retention upmost using qualitative methodologies: focus groups

Abstract:
The purpose of this research is to develop a hybrid framework to model first year student academic success and retention for Under Represented Minorities (URM) comprising African Americans, Hispanic Americans, and Native Americans. This model was built by incorporating quantitative and qualitative results to obtain an adequate understanding of URM student retention and academic success and modeling their performance and retention during freshman year. This paper will focus on highlighting the qualitative (focus groups) part of this research.
Focus groups were designed to elicit responses from participants for identifying factors that affect their retention the most and provide more knowledge about their first year experiences, academically and socially.

Introduction:
Increasing student retention and academic success in Science, Technology, Engineering, and Mathematics (STEM) disciplines have been among the goals of higher education institutions for a long time. Significant efforts have been made to predict student retention in higher education and to understand the process of dropping out of college\textsuperscript{1-3} by developing theoretical models of student retention using associated factors. Seymour\textsuperscript{4} reported that both enrollment and retention rates in STEM disciplines have declined. More specifically, Tinto\textsuperscript{5} reported that freshmen year has the highest dropout rate especially in the first six weeks of the first semester. Statistics show that students of color have higher attrition rates compared with other groups, although this trend has been decreasing over the past twenty years\textsuperscript{6-8}. These groups tend to enroll in STEM majors in small numbers and leave in higher numbers\textsuperscript{9,10}.

The purpose of this research is to develop a hybrid framework to model first year student academic success and retention for URM comprising African Americans, Hispanic Americans, and Native Americans. This model was built by incorporating quantitative (genetic algorithm) and qualitative (focus groups) results. Obtaining an adequate understanding of URM student retention and academic success and modeling their performance and retention during freshman year, serves institutions by identifying at-risk students in STEM fields.

The focus groups participants were former Summer Transition Program (STP) students over a three year period of time, 2008-2010. The STP is a residential four week program for entering URM freshmen targeting fourteen STEM majors including engineering, natural sciences, and mathematical sciences. Focus groups were designed to elicit responses from participants for identifying factors that affect their retention the most and
provide more knowledge about their academic and social first year experiences. More
details about the STP can be found in\textsuperscript{10}.

Qualitative Research Design

Qualitative research methodologies are effective way in terms of analyzing non-
quantitative data or data in the form of text rather than numbers. Researchers defined
qualitative research as an “important modes of inquiry for the social sciences and applied
fields, such as education, regional planning, health sciences, social work, community
development, and management.”\textsuperscript{11}. The strength of qualitative research comes from three
main points 1) “exploration and discovery” in which it aims to learn about a specific
group of people, 2) “context and depth” by providing an insight into people’s behaviors
and experiences, 3) “interpretation” where it gives an understanding of the reasoning
behind people’s behaviors\textsuperscript{12}. Qualitative research includes several strategies for data
collection such as observations, content analysis of existing sources, interviews, and
focus groups. This study will employ focus groups as a strategy for collecting data to gain
insights into the STEM students’ experience at Virginia Commonwealth University
(VCU) and identify participant characteristics that may prevent him/her from continuing
in a STEM discipline.

Focus groups

The focus groups technique used in this research to get a deep insight on major academic
and environmental factors that impact URM student accomplishments the most and elicit
responses regarding their freshman year experiences. Sixty three participants in the VCU
LSAMP summer transition program over a three year period (2008-2010) were invited to
participate in the focus groups sessions. The program participants were incoming
freshmen in STEM disciplines who were African American, Hispanic American, and
Native American. It is a self-selecting program designed to enhance participants’
precollege preparation and ensure a smooth transition into college. Each year,
approximately twenty two participants choose to enroll in the program. Participants’
majors were biology, all engineering fields, mathematical sciences, forensic sciences,
chemistry, and environmental studies. Of the participants, approximately 59% were
female. Sixteen students attended the three meetings conducted in the spring of 2011 of
whom two students were non-STP participants. These two students responded to an
invitation for non-participants to get an insight into other freshman year experiences for
students who did not have a chance to participate in the program. Participants’
demographic and other characteristics are described in table 1.

This group of students was selected for the study due to its diverse representation of the
VCU population in STEM fields. Students were primarily selected to participate in the
program based on their high school GPA, SAT test scores, math placement test scores,
gender, race/ethnicity, and intended major. Academic and demographic variation among
selected groups was obtained each year. Based on that, STP participants are considered a
valuable data source for this model. Students are diverse, had a precollege experience,
and were exposed to various services and activities during freshmen year. This rich
college experience will provide the study with a better understanding of freshmen college experience and factors that impact their retention. An approval from the Institutional Review Board for Research Including Human Subjects (IRB) was obtained.

Focus group instrumentation

The focus group protocol was designed for this study to elicit responses from participants about their freshmen year college experiences and determine which variables have the most impact on student academic success and retention (see appendix A). Seven open-ended questions were asked of each group, and students were informed about the confidentiality of all the sessions. The first question discussed reasons behind students’ motivation to major in STEM fields. The second and third questions focused on analyzing freshman year experiences, the difficulties participants had, and how they handled them. The fourth, fifth, and sixth questions determined which academic, demographic, and social variables have the most impact on student academic success and retention. The final question examined the extent to which precollege intervention programs could affect student retention in a STEM discipline.

Three focus groups were conducted with a total of sixteen participants; two of them were not former STP participants. The first group had nine participants, the second group had five, and the third group had two. The duration of each meeting ranged between 20-50 minutes based on the number of participants. All sessions were tape recorded (audio only) and later transcribed. In qualitative research, the richness and quality of collected data is not dependent on the sample size. Thus, a total of 16 out of 63 participants considered enough to reach a sufficient depth of information regarding the purpose of conducting focus groups. Prior to conducting each session, a demographic survey was administered to each participant in order to get an insight into participants’ diverse backgrounds.

The analysis approach used is content analysis which is a very effective method in analyzing data in textual context. This approach is used to describe, analyze, and summarize patterns and trends observed from the collected data. It also analyzes what do participants talk about the most and how trends are related to each other. Trends and patterns were analyzed within and among groups.

Focus Group Sessions Analysis

Table 1 summarizes the background information on all participants. It was observed that a total of (n=16) students participated in the three sessions: twelve females and four males. Fifteen participants were African Americans and one was Hispanic American. All participants were majoring in STEM disciplines except one student who switched from STEM to a major in Business Administration. Eight students were placed into Calculus I (Math 200) and the average SAT score was 1620. The average high school GPA was 3.6 and the average study hours were 3.7 hours. Seven students indicated that they were the first generation to go to college. Only three students declared that they work during the academic year. Students’ responses varied on how this affects their college life and
participation in university activities. One student responded that she still had time to participate in organization’s activities because she only works for a couple of hours per week; another responded that she managed her time between work and university activities; and one responded that he had no free time at all.

Table 1 Focus Groups Survey Summary Results

<table>
<thead>
<tr>
<th>Gender</th>
<th>Race/Ethnicity</th>
<th>Major</th>
<th>Math Level</th>
<th>Work during academic year</th>
<th>First Generation Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>African American</td>
<td>Biology</td>
<td>Algebra</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Male</td>
<td>Hispanic American</td>
<td>Forensic Science</td>
<td>Pre-calculus</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Biomedical Engineering</td>
<td>Calculus I</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical and Computer Engineering</td>
<td>Calculus II</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanical Engineering</td>
<td>DE</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business Administration</td>
<td>Other</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q1. Motivation for majoring in STEM discipline: In analyzing the students’ responses, it was indicated that parents played a significant role in inspiring students to consider majoring in STEM. A majority of students believed that their parents motivated their decision to major in STEM in the first place. Some students saw their parents as role models and tried to follow their steps and pursue a career in STEM fields. Relatives and friends could be a good source of motivation as well.

Some students developed their mathematics and science skills since their high school period and they realized that STEM fields are commensurate with their career goals and abilities. Some stated that they were interested in a specific field of study in high school. A few students pointed to the importance of participating in a science or engineering program in high school. They were exposed to some college courses such as computer programming, biology, and environmental sciences. They indicated that these programs
introduced them to science and engineering and to hands-on experiments. Some mentioned the effect of high school teacher, and that the main reason for majoring in engineering was a TV show that was an inspiration since childhood.

Q2. Freshman year experiences: Students’ responses varied when they were asked to evaluate their freshman year experience. A majority of students responded that it was easy. Academically, students referred to their high school preparation, participation in science and engineering programs, and their participation in the STP as factors that helped in making first year introductory courses easier and smooth. The mathematics and chemistry courses of the STP got high credits from students, although they were just a review for some of them. Socially, all students showed their concern for adjusting to college life and the new environment but it was easy for them because of their prior experience in high school programs and the STP.

A few students described their freshman year experience as moderate. These students mostly had difficulties in academic adjustment. For example, students who came with AP credits and were placed in the advanced course level had more pressure to be a freshman in a sophomore class level. From the social perspective, students found the STP very helpful for adjusting to VCU and meeting new friends, especially engineering students where they got familiar with the engineering buildings and labs. In addition, some found that joining student organizations such as NSBE (National Society of Blacks Engineers) was very helpful to get involved in college social life.

Three students said that their freshman year experience was difficult but overall they enjoyed it. Being away from home and taking all the responsibility of being placed in upper level classes was the difficult part of the experience. Also, some found it hard to balance between priorities. One of the students in the first group who did not participate in the STP described her freshman year experience as “lonely”. The reason was that she did not know anybody at the beginning and later she joined NSBE to build relationships and find the support she needed to continue.

Q3. Difficulties in STEM during freshman year & how they were handled: Getting more specific about freshman year difficulties, students’ responses, among all groups, were mostly from an academic perspective. It was observed that many students had difficulties in their first chemistry class. Even though most of them took the chemistry class during the STP, it was hard for them to keep up with such a demanding course and grasp any new material. The chemistry class was not added to the STP until the second year of the program. Due to this, a few students stated that it would be helpful if it was available at the beginning of the program; one mentioned that the last chemistry class she took was in 10th grade, which is considered a big gap. Students revealed that they had to work harder, get tutoring, join SI sessions, and attend other chemistry classes taught by different instructors. Besides chemistry, a student expressed that her difficulty was in the introduction to engineering class because of the professor who expected that all students should know the basic material already, and moved forward from there. The student
stated she had to put double effort and grasp the material quickly to improve her performance.

Upper level classes such as differential equations, physics, and programming were on the list of difficult courses as well. It was observed that these courses required more workload than expected for a freshman especially if all three were taken at the same time and if the freshman never took physics in high school. Students handled this difficulty by attending SI sessions, going to the library and working with classmates. Online courses were a problem for freshmen as well. A student revealed that he was not ready for that kind of classes which puts more responsibility to check homework and due dates online without having someone reminding him about the class duties.

Socially, students from the three groups agreed that distractions and peer pressure were difficult things to handle in freshman year. Students came to college, lived with roommates, and had no curfews as they used to have in high school. It was hard to take the full responsibility to avoid these distractions and maintain academic success. A student from the second group stated that the whole new teaching environment while another said that the campus life were not as they expected them to be when they came to the STP.

Q4. Indicators of freshman year performance and retention: High school preparation was a significant indicator of freshman year performance for almost all the students. A majority of students revealed that their high school mathematics and science background helped them to get good grades in their first semester’s introductory courses. Unlike what we observed from the previous questions as some students complained about their weak chemistry and physics preparation and how difficult it was for them to handle it.

A couple of students stated that their good academic preparation in high school was due to their participation in mathematics or science programs. One student in the second group said that he did not have enough preparation in high school for college due to his school environment (small classrooms) but he emphasized that his father was the most influential factor for encouraging him to major in engineering. Also, a few students highlighted the impact of their strong support system, family and friends, on their freshman year performance. Usually family members keep up with the students and try to push them to achieve academic success.

Advanced Placement (AP) classes were among the significant indicators of good performance in freshman year. Some students from all groups claimed that these advanced classes gave students an insight into college classes with regard to work-load and hard work. None of the students said that SAT scores were an indicator of their freshman year performance even when they were asked about it. Self-motivation and the ability to be independent were among the top freshman year performance indicators as well. Most students emphasized that when they were self-motivated, they worked hard to achieve their goals and maintain academic success.
From a demographic perspective, it was observed that gender was not an issue for any male student and non-engineering female student. However, almost all female students in engineering indicated that it was challenging and motivating at the same time for them to be “a minority within a minority” referring to gender and race. One engineering male student stated that he came from a high school where 90% of the population was Black and now he is the only Black in his major. The student added that “I felt like I want to prove that only I am successful among all Blacks as I am the only Black graduating in this major.” One student pointed to the safe and diverse environment as a good indicator of freshman year performance.

Q5. Factors that impacted student academic performance: Most students in the three groups said that they had not thought of switching to another major because they did well in their classes or got a good GPA especially in their first semester. They also added that this increased their self-motivation that they can do even better if they worked harder in spite of facing any possible difficulties. A student, who dropped out of the engineering school, revealed that he did not do as well in the sophomore year as he did in the freshman year. The student added that after that he lost his self-motivation and started thinking about leaving engineering.

One more engineering student thought of leaving engineering when she got bad grades at the beginning of her freshman year. She had to re-motivate herself since she was the first to graduate from high school in her family, the first to go to college, and all of her family members were looking forward to seeing her graduating with an engineering degree. Another engineering student made the point that switching to a different major meant one more year in college, and the decision should be made in the freshman year to avoid more delay in graduation.

Some students indicated that even though they did not get good grades, or their GPA was not what they expected, they moved forward because of their self-motivation and their family’s support. One student added that this was his only option and he realized that this is what he wanted to do.

Q6. Environmental Factors that affected student academic performance and retention: Family and friends had the most influence on student retention decision. A majority of students revealed that their family member(s) formed a big support system. They tended to check on how they were doing in college and tried to push them towards academic success wisely. As for friends, most students stated they played a significant role in their adjustment to the college environment and improvement in academic performance especially for the STP students. They started their freshman year knowing many friends and attended the same freshman year classes together. Some students revealed that their classmates were very helpful too especially in large classes where it was hard to build a relationship with the professor. Some students stated that they usually refer to upper class
students because they know the material, study habits, and the best teachers, and can give the best advice.

Some students pointed out that their advisors did not help at all; one student said that her freshman year advisor was really helpful, while the rest of the students did not mention the role of their advisors in their freshman year at all. In addition, a couple of students stated that their professors did not influence them at all; some of them stated that it depends on the professor; and few stated that their professors were very helpful whenever they needed their assistance and that they were acting more nicely and supportive in their offices than in class. In addition, a student claimed that teaching assistants sometimes could be more helpful than professors themselves. A couple of students highlighted the role of high school teachers in motivating them to do better in college. Money and roommates too were on the list as good and not very good influential factors, respectively.

As for the STP, some students emphasized on the influence of having friends from the program and how it made them more comfortable and they could adjust easily to VCU. Moreover, a few students highlighted the role of the mentoring program in maintaining academic success and getting the advice they need when they had any issue.

Q7. The STP experience: The STP impact on participants’ pre-college preparation was divided clearly into academic and social. A majority of participants in both groups stated that the program was more helpful from the social perspective. Students said that they made new friends with diverse experiences, became familiar with the college environment, and did not get lost in the fall semester; adjusted to being away from home before fall started; learned time management because in high school they did not have free time as in college; got used to campus and city life; gained good dorm experience especially when they had a roommate with the same major; and found the study skills class to be good. One student, however, from the first group stated she did not utilize it well.

Some biology and forensic science students from the first group stated that the program was more beneficial socially than academically because there were lots of mathematics and engineering activities.

Academically, students from the first group stated that they learned how college classes are, and realized that they need to work harder; boosted their self-esteem when they got good grades during the program; got more confident in freshman year classes; and found a study buddy. The second and third groups agreed that the mathematics and chemistry classes served as a good review before the beginning of fall semester. Some students from the second group stated that they knew what to expect in college, and the science class helped in learning how to write laboratory reports. The third group’s students stated that the study skills class was good in teaching them time management.
Discussion:
In examining the results obtained, it was indicated that students who had good preparation in high school tended to have better first year experiences due to their solid preparation, especially in their first semester classes. High school GPA; percentile rank; high school STEM programs; mathematics and science teachers; personal interests in mathematics and science; and mathematics placement test scores are all indicators of student high school preparation. Interestingly, SAT scores were considered an irrelevant indicator by participants of focus groups.

AP classes had a significant impact on student performance and retention in STEM as well. Students started with upper level courses and they did not have to worry about being behind their peers in the freshman year. Not only this, it gave students an insight into college classes, and they learned about the demanding nature of this type of classes. Although they found taking sophomore courses while being freshmen slightly difficult to handle, they nonetheless showed great interest in being ahead of their peers and passing more college classes (i.e. earning more college credits) which allowed them to finish college earlier.

Gender was a strong predictor for both URM and majority groups. As for race/ethnicity, URM engineering students, particularly females, tended to have more concerns for being a URM in a STEM major as compared to their peers from other non-engineering majors. It is believed that the reasoning behind race and gender being significant factors for engineering students has to do with the nature of engineering courses, laboratories, and projects. Engineering courses are more demanding with regard to team work in and outside classroom. Due to this, it is very important for these students to maintain high expectations, and put in double the effort to achieve good performance. This also explains why most URM students joined race related student organizations looking for support and advice. Some revealed that the diverse nature of VCU had a positive impact on their first year adjustment. Mostly, students with higher self-motivation had strong commitment to succeed and graduate with a STEM degree.

Freshman year academic performance plays a significant role in student dropout/persistence decisions. All students expressed their concerns about freshman year classes, both introductory and upper level. The overwhelming workload and lack of knowledge about college credits or course load made students put in double the effort for success. Responses of students on handling freshman year difficulties highlighted the variation in student retention behaviors. Some students worked hard to maintain good grades while others decided to withdraw from the class so that the overall GPA would not be affected. Getting good grades in the first semester has a great impact in motivating students and encouraging them to maintain high performance from the very beginning. Retention behavior for students who did not perform well in their freshman year differs from one student to another. Some start thinking that this is not what they should be doing and that they could achieve better in other non-STEM majors especially if they had difficulties in mathematics, which is a core subject in most STEM majors. Dropping out
of STEM fields could happen unless students got self-motivated by other external factors such as family members or an advisor; this is discussed later in this section. However, some students would continue regardless of their performance. This could be influenced by the number of college credits they passed and the fact that they still could graduate with their peers without taking more year(s) to graduate by switching to a different major.

Another evidence of differences in students’ behaviors is the learning process inside and outside the classroom. Each student follows different strategies to learn although similarities would be found. Those strategies are usually influenced by the class type and student major. Engineering students look for teamwork and support from upper class students by joining student organizations or hanging out in the engineering laboratory. On the other hand, for non-engineering students, individual support, such as getting SI sessions, would be enough to be satisfied with their performance in the class.

Incoming freshman intervention programs, for the most part, positively impacted participants both academically and socially. Such programs helped students to adjust to college and gave an insight into what to expect. Participants in such programs were well prepared for college life and learned how to be independent and well-organized. On the other hand, some participants needed much more than that in order to succeed in college and persist in a STEM field afterwards.

Conclusion:
This paper focused on using focus groups methodology to elicit responses from participants for identifying factors that affect their retention the most and provide more knowledge about their first year experiences, academically and socially. Overall, precollege preparation & family background were found to be strong predictors of academic success and retention. In addition, freshman year academic performance & GPA are considered strong predictors of student retention. Apparently, empowering student with self-motivation has a great influence on student decision to continue in STEM fields.

Analyzing URM student characteristics and experiences allows institutions to employ available programs, resources, and activities to meet different students’ needs. Besides, exploring student experiences and characteristics, and predicting student performance and retention would have a great impact on student advising process.

References:


Appendix A: Focus Group Questions

1. What was the main thing that motivated you to major in STEM?

2. How do you describe your freshmen year experience? Would you say it was…easy, moderately easy, hard, or very hard? Why?

3. Can you talk about at least one thing (academic or social) that made it difficult for you to be successful in your STEM major during your freshmen year? And how did you handle it?

4. What are the most important factors that you believe indicated how well you would do in your freshman year? Such as SAT scores, gender, math placement test scores, high school performance.

5. Do you think that your freshmen year academic performance was a significant influence of your decision whether to pursue in STEM or switch into a non-STEM major? Which one of the following could impact your decision the most: your first/second semester GPA, first year cumulative GPA, Math courses performance, or college credits earned?

6. What about environmental factors such as professors, roommates, friends, advisors if any, family members, resources? Were they significant in influencing your persistence/dropout decision as well?

7. For the summer transition program participants, do you feel it was helpful to participate in a precollege preparation program? How was it helpful?