



## **STEM Workshops for Transfer and Retention Program at a Hispanic Serving Institution**

### **Dr. Pablo Biswas, The Mercer University**

Dr. Pablo Biswas joined the Mercer University as an Assistant Professor in the Industrial Engineering and Industrial Management Program in the fall of 2014. Previously, he was an Assistant Professor in the Engineering, Mathematics, and Physics Department at Texas A&M International University in Laredo, Texas. He received Ph.D. and M.S. in Industrial Engineering from Louisiana State University, Baton Rouge, Louisiana, and B.S. in Mechanical Engineering from Bangladesh University of Engineering and Technology, Dhaka, Bangladesh. He began his professional career as a Technical Business Consultant. Dr. Biswas's research interest is in the area of supply chain management, lean production systems, simulation, inventory control, operations research, and information systems.

### **Dr. Rohitha Goonatilake, Texas A&M International University, Laredo, Texas**

Dr. Rohitha Goonatilake, professor of mathematics, received his Ph.D. in Applied Mathematics from Kent State University, in Kent, OH in Fall 1997, three masters in the areas of applied mathematics, mathematics, and actuarial sciences, and a bachelor's in mathematics/science. He joined TAMIU in the Summer of 1999 and has completed 14+ years of service for TAMIU. He and his team was recently awarded a \$1.2 million NSF award to promote mathematics education in the area of need in Laredo through providing scholarships to juniors and seniors at TAMIU to prepare talented, skillful, and highly qualified teachers to teach immediately after graduation. Dr. Goonatilake was a recipient of the Scholar of the Year Award in 2006 and the University Honors Faculty of the Year in 2013. He was a PI for more than three program-funded grants and Co-PI for more than 10 different program grants since joining TAMIU. He has a very active research agenda that involves network anomaly detection, probability, disease prevalence, and microeconomics. He was extensively involved with many STEM activities throughout years for local high school and middle school students, outreach efforts with local high schools, and other community involvements for many years through enrichment workshops and summer opportunities for the local community.

### **Mr. Gerardo Javier Pinzon PE, Texas A&M International University**

Mr. Pinzon is the STEM Advisor & Laboratory Manager in the Engineering, Mathematics and Physics Department at Texas A&M International University (TAMIU). He is currently a PhD Candidate (ABD) in Environmental Engineering at Texas A&M University at Kingsville (TAMUK). He holds a Masters of Environmental Engineering from TAMUK, a Masters of Business Administration from TAMIU and a Bachelor of Science in Mechanical Engineering from the University of Texas at Austin. He is also a Professional Engineer registered in the State of Texas.

### **Dr. Mahmoud Khasawneh, Texas A&M International University**

Mahmoud T. Khasawneh is as an Assistant Professor of Systems Engineering at Texas A&M International University. Dr. Khasawneh got his Ph.D. in Engineering Management in the Department of Engineering Management and Systems Engineering at Old Dominion University in August, 2012. He received an M.E. degree in Systems Engineering from the same department in May, 2009. He received a B.S. degree in Management Information Systems (MIS) from the department of Business Administration at the Faculty of Economics and Administrative Sciences at the Hashemite University, in Zarqa, Jordan, in 2007. His research interest are focused on Engineering management and systems engineering applications in healthcare, manufacturing, operations management, business, and other industries; modeling and simulation of complex systems; distributed networked operations; Engineering Education

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## **Abstract**

In recent years, it has become a challenge to improve the recruitment and retention of highly motivated Hispanic and other minority students and to keep their interests active in the engineering discipline until their graduation so that they can join the workforce as professional engineers. The STEM - Minority Outreach and Retention Enhancement Program for Transfer and Retention (STEM-MORE-TRP) and the Serving Youth in Science, Technology, Engineering, & Mathematics Program (SYSTEM) are designed to recruit the engineering students through a number of enrichment activities, including two-week residential Engineering Workshops at a major Hispanic-Serving Institution (HSI) in southern Texas. Both STEM-MORE-TRP and SYSTEM introduce participants to several engineering disciplines and allows them to interact with engineering faculty and staff through several activities, including information sessions, field trips, laboratory tours, and design projects. Based on the TRP and SYSTEM curriculum, The Engineering, Mathematics, and Physics, Biology and Chemistry departments at a major Hispanic-Serving Institution (HSI) in southern Texas, developed two-week long “Transfer and Retention Program (TRP) workshop” and “Summer Engineering workshop (SEW) during the summer at the university. Also, this provides the extent of what has worked in achieving the goals set out for the cohort. Both of the platforms funded by the U. S. Department of Education envisioned at transferring and retaining highly motivated Hispanic students into the new Bachelors of Science in Systems Engineering at the university. The activities were done in three different stages: recruit students and provide the theme of the program, provide a series of enrichment activities, including advising and faculty mentoring, and participation in the workshops at the university.

## **1. Introduction**

In the United States, the Hispanics are the fastest-escalating and youngest ethnic group. It is projected that the Hispanics will comprise 31 percent of the U.S. population by the year 2060 and will become the largest ethnic group by then<sup>[1]</sup>. In recent years, it has become a challenge to improve the recruitment and retention of highly motivated Hispanic and other minority students and to keep their interests active in the engineering discipline until their graduation so that they can join the workforce as professional engineers. Therefore, the programs are being developed to encourage and motivate the minority students toward STEM education with the help of the US Department of Education. This research focuses on two ongoing programs that are designed to improve the recruitment and retention of highly motivated Hispanic and other minority students into the Systems Engineering program at Texas A&M International University (TAMIU). This programs are part of two grants from the US Department of Education, Minority Science and Engineering Improvement Program (MSEIP) titled “STEM Minority Outreach and Recruitment Enhancement (STEM-MORE)” under award number: P120A110067<sup>[2]</sup> and “The Serving Youth

in Science, Technology, Engineering, & Mathematics Program (SYSTEM)” under award number: P031C110118<sup>[3]</sup>. These grants are designed to increase the number of Hispanic and minority students attaining Science, Technology, Engineering, and Mathematics (STEM) degrees. This paper addresses the Transfer and Retention Program (TRP) and the Summer Engineering Workshop (SEW), which are parts of these overall programs.

## 1.1 Background Information

The minority serving university such as TAMIU, student body comprises of 90% Hispanic students of which most are economically disadvantaged and are under prepared when entering the university. The City of Laredo sits on the boarder of Mexico and has a much lower per capita income when compared to both the state and national averages. Data from the U.S. Census Bureau 2010 and the 2005-2009 American Community Survey 5-Year Estimates shows that the City of Laredo has the following characteristics:

- (a) The Hispanic population is 95.41%
- (b) The per capita income is \$15,114 compared to \$53,042.0 nationally.
- (c) The percent of residents living at or below the poverty income level is 29% compare to 14.5% nationally.
- (d) Over 22.5% of the population has less than a 9<sup>th</sup> grade education compared to 6.4% nationally.
- (e) Only 12.8% hold a Bachelor’s degree compared to 17.4% nationally.
- (f) Only 5% hold a master’s or higher degree compared to 10.1% nationally.

This presents a challenge in motivating our graduating high school students to pursue a career in engineering.

TAMIU has seen an average enrollment increase of 10% annually over the past five years. In the fall 2010 TAMIU had 85% undergraduates, 91% Hispanic, 60% female, 72% economically disadvantaged (Pell Grant recipients), and 45% first-generation students. Furthermore the students graduating from K-12 are generally less prepared for higher education than the national average, we believe due to the economic situation most are in and the fact that almost half are first-generation, (the first in their family to attend higher education). For these same reasons, we believe, TAMIU also has a high number of students that do not complete the program and never earn their Bachelor’s degree. This presents a challenge in motivating our current and future students to remain with their engineering goals and graduate from our Systems Engineering or Pre-engineering programs.

## 1.2 The Challenge

In a study the Bayer Corporation<sup>[12]</sup> found 40 percent of the country's female and underrepresented minority (URM) chemists and chemical engineers working today were

discouraged from pursuing their STEM career at some point in their lives. The survey also asks the chairs about their institutions track record recruiting and retaining female and URM STEM undergraduates, preparedness of these students to study STEM, the impact of traditional introductory STEM courses on female and URM students and barriers these students face pursuing their STEM degrees. Similarly, Gonzalez and Pinzon<sup>[7]</sup> found that the significant challenges in educating our students including:

- A high percentage of STEM students are suspended for failing to meet the standards for good academic standing at the end of their first academic year (these students also lose their eligibility for financial aid).
- A high percentage of students experiencing difficulty comprehending the academic language of their STEM courses and
- Failure to comply with institutional academic requirements for graduation is high, particularly among STEM students.
- The challenge of the university is to recruit new students and retain our existing students. The piece of this challenge the TRP and SEW addresses is to retain and enhance the experiences in engineering disciplines.

## **2. Equivalent work**

At the University of Texas, Pan American, they have an approach that includes several activities<sup>[4]</sup>. First they implemented an enhanced student service program which includes STEM advising and mentoring and a student assistant program specifically for Calculus I. It includes a curriculum reform program where they develop courses using the Challenged Based Instruction (CBI) method<sup>[5]</sup>. This method is a form of inductive learning<sup>[6]</sup> designed to increase the student's involvement and motivation in a course by challenging them to seek the course material. The third activity includes faculty development seminars and workshops on teaching using the CBI method. Finally the last activity is a dual enrolment program with South Texas College, a local college. In contrast, our approach is much simpler albeit perhaps not as effective. It only involves a summer engineering workshop for students and an articulation agreement with the local community college. Our faculty participated in the CBI workshop that was offered by the University of Texas, Pan American program however that is not part of the activities described in this paper. Their results are mostly not yet available.

The Summer Engineering Institute<sup>[11]</sup> is a program at Cañada College in Redwood City California, very similar to the one presented here that includes two-week summer engineering workshops held on the campus of San Francisco State University and taught by the faculty from both institutions. It is aimed at underrepresented and educationally disadvantaged students pursuing STEM careers. The workshop introduces students to the engineering educational system and the profession, is designed to recruit students into the engineering fields, increase awareness of the resources and skills needed for success, and to increase the student's knowledge

of the engineering topics. Their program was also funded by the US Department of Education, Minority Science and Engineering Improvement Program (MSEIP). At San Jose State University<sup>[16]</sup> they offered a 10 day residual summer transition program called EXCEED: Excellence in Your Engineering Education designed to improve retention and graduation rates. The University of South Alabama offered a program called Freshman Research Experience in Engineering<sup>[13]</sup> (FREE) includes a two-week workshop in which the students work on a project on either robotics or composite materials. They aimed in retaining the general student population in STEM. They claim an increase in the student's critical thinking skills. In comparison to the programs at TAMIU, is specifically aimed at the underrepresented group particularly the Hispanic population. Furthermore, TAMIU generally accept all of the existing students that completed the Foundations of Engineering I course regardless of GPA while the FREE program aims specifically at the high achieving pre-college students. They select students with high ACT, GPA scores. The Summer Transfer Engineering Workshop (STEW)<sup>[14,15]</sup> is a two-week residential workshop held at the Dwight Look College of Engineering at Texas A&M University in College Station, Texas. It is designed to increase the number of minority students in engineering. The workshop includes information sessions, field trips, laboratory tours, and design projects. This program is similar to the one presented here and actually involves the same students. This makes assessment difficult as both programs are influencing the same student population concurrently.

### **3. Recruitment**

TRP and SEW are developed to improve the recruitment and retention of highly motivated Hispanic and other minority students, into Systems Engineering at TAMIU. This program already working towards building based on the existing agreement with Laredo Community College (LCC) to develop an engineering specific transfer agreement. The goal of the agreement is to serve students in the Laredo region who are interested in receiving an Associate's Degree before seeking a Bachelor's Degree. A major goal is to facilitate the transfer of LCC students into Systems Engineering Program at TAMIU by allowing them to take first two years of core and engineering courses at LCC.

It is envisioned that, under the new articulation agreement, students can earn Associate's Degree of Science/Engineering from LCC and enter TAMIU as juniors in our Systems Engineering Program. This agreement is modeled after the existing agreement between TAMIU and Texas A&M at College Station. While LCC may choose to develop a few courses to make this possible, LCC students will be allowed to take courses at TAMIU and transfer those to LCC towards their Associate's Degree. As a part of this agreement, LCC students who wish to transfer to TAMIU will be encouraged to participate in a summer engineering workshop after completing their first year at LCC. This workshop introduces transferring students to systems engineering design and prepares them for the rigors of university life. The summer workshop offer real-world learning experiences to first-year engineering students. Features of the program are: 1) Students will

actively sought to join a cohort of pre-engineering students to participate in a two-week engineering design and research experience at TAMIU. The top 35 applicants will be selected from the cohort. 2) Students will take a prescribed set of courses including Foundations of Engineering I and II at TAMIU or LCC in their first year. 3) Students will participate in a two-week engineering design and research experience at TAMIU during summer following their first year.

Table 1: Engineering student enrollment by ethnicity and gender

Semester	Major	Ethnicity		Gender		Total
		Hispanic	Non-Hispanics	Females	Males	
Spring 2015	Pre-Engineering	150 (91%)	14 (9%)	21 (13%)	143 (87%)	164
	Systems Engineering	107 (91%)	11 (9%)	12 (10%)	106 (90%)	118
Fall 2015	Pre-Engineering	150 (91%)	14 (9%)	21 (13%)	143 (87%)	164
	Systems Engineering	107 (91%)	11 (9%)	12 (10%)	106 (90%)	118
Spring 2014	Pre-Engineering	150 (91%)	14 (9%)	21 (13%)	143 (87%)	164
	Systems Engineering	107 (91%)	11 (9%)	12 (10%)	106 (90%)	118
Fall 2013	Pre-Engineering	179 (94%)	12 (6%)	21 (11%)	170 (89%)	191
	Systems Engineering	105 (91%)	10 (9%)	12 (10%)	103 (90%)	115
Spring 2013	Pre-Engineering	125 (93%)	10 (7%)	14 (10%)	121 (90%)	135
	Systems Engineering	81 (94%)	5 (6%)	13 (15%)	73 (85%)	86
Fall 2012	Pre-Engineering	139 (93%)	11 (7%)	15 (10%)	135 (90%)	150
	Systems Engineering	82 (95%)	4 (5%)	15 (17%)	71 (83%)	86
Spring 2012	Pre-Engineering	105 (93%)	8 (7%)	7 (6%)	106 (94%)	113
	Systems Engineering	60 (91%)	6 (9%)	14 (21%)	52 (79%)	66
Fall 2011	Pre-Engineering	107 (94%)	7 (6%)	7 (6%)	107 (94%)	114
	Systems Engineering	62 (93%)	5 (7%)	15 (22%)	52 (78%)	67

The enrollment history of engineering students at TAMIU in Table 1 is very promising. However, the recruitment, retention, and graduation of these students have been the focus for many years. The flyer and application materials of the TRP and SEW workshops were distributed to all students enrolled in the two-year Pre-Engineering Program, the B.S. Systems Engineering Program and LCC students who intends to transfer to TAMIU Engineering programs at the beginning of the spring 2014 semester. All applicants were asked to submit a 200 to 300 word typed essay describing their educational goals and career plans; their college transcripts were also requested. Apart from the carrier plan essay, completion or in-progress of the following courses were needed: Foundations of Engineering I and II, Calculus I, II, and III, and University Physics I and II, became the focus of consideration for their applications being selected. A total of thirty five students and eighteen students were selected to form the cohort for

TRP and SEW, respectively. All of the students were Hispanic. TRP participants were divided into five groups randomly and SEW participants were divided into three groups randomly, and all groups are assigned to a faculty motor for the workshop.

### 3.1 Enrollment of the sew workshop 2013

The duration of TRP and SEW workshops are two weeks with full day activities. During 2012 - 2013, almost all participants were Hispanic and were from TAMIU. The agreement between LCC and TAMIU was not in place in the years 2012 and 2013. Hence it was difficult to recruit LCC students during year 2012 and 2013 time around. Some of the student's characteristics are shown in Table 2 below.

Table 2: Student participants' characteristics 2012-2014

<b>Workshops</b>	<b>% Hispanic</b>	<b>% TAMIU students</b>	<b>% LCC students</b>	<b>GPA</b>
<b>TRP 2012</b>	100	100	0	2.92
<b>TRP 2013</b>	94	100	0	3.275
<b>SEW 2013</b>	96	100	0	2.92
<b>TRP 2014</b>	100	33	67	3.241
<b>SEW 2014</b>	100	88	12	3.097

The TRP workshop was offered in May and the SEW was offered in July excluding weekends.

### 3.2 The TRP and SEW workshops in 2014

The TRP and SEW summer workshops 2014 was the third TRP and second SEW workshops offered to TAMIU and LCC students. A total of 43 applications were submitted and among them thirty-three (33) students were selected for the TRP workshop, including five female students. This year (2014) the female participants decreased from 7 to 5, but community college student participants increased from 0 to 16 [Table 2] among which two of them were female students. The TRP and SEW workshops were offered from May 19 thought May 30, 2014 and July 21 thought August1, 2014, respectively, from 9:00 am to 4:00 pm excluding weekends. The students worked in small groups on engineering projects of their choice approved by the instructor. At the end of the workshop each group presented their project to the rest of the students. Figure 1 represents the students' participation breakdown based on their institution. Figures 2 and 3 represent the students' participation breakdown based on gender and major, respectively.

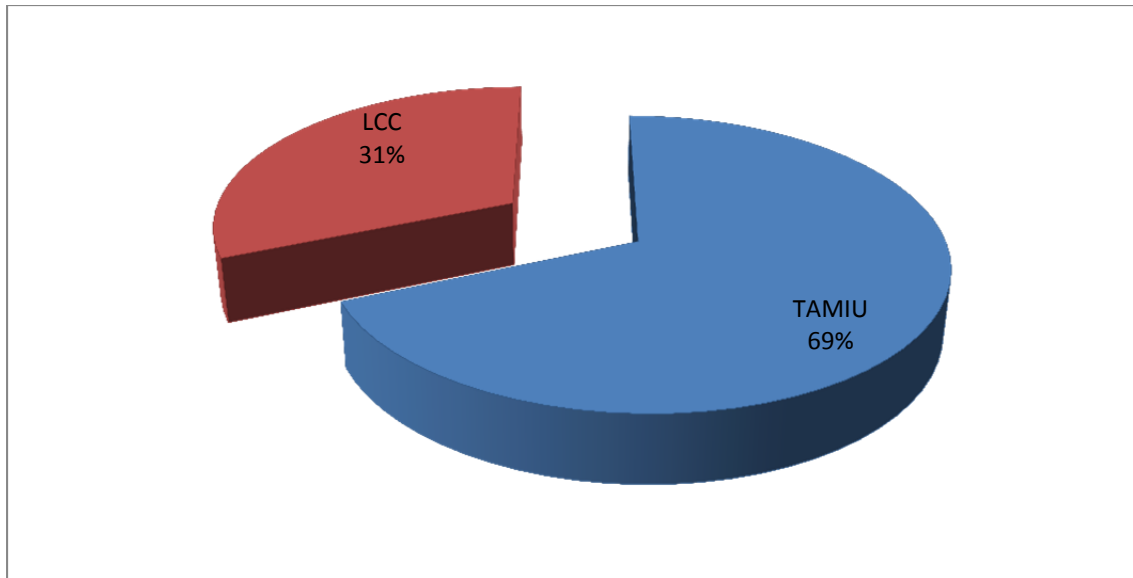


Figure 1: Students' participation based on institutions at SEW 2014

The workshop was offered from July 21 through August 1, 2014, from 9:00 am to 4:00 pm, excluding weekends. The students worked in small groups on engineering projects of their choice, approved by the instructor. At the end of the workshop, each group presented their project to the rest of the students. Figure 1 represents the students' participation breakdown based on their institution. Figures 2 and 3 represent the students' participation breakdown based on gender and major, respectively.

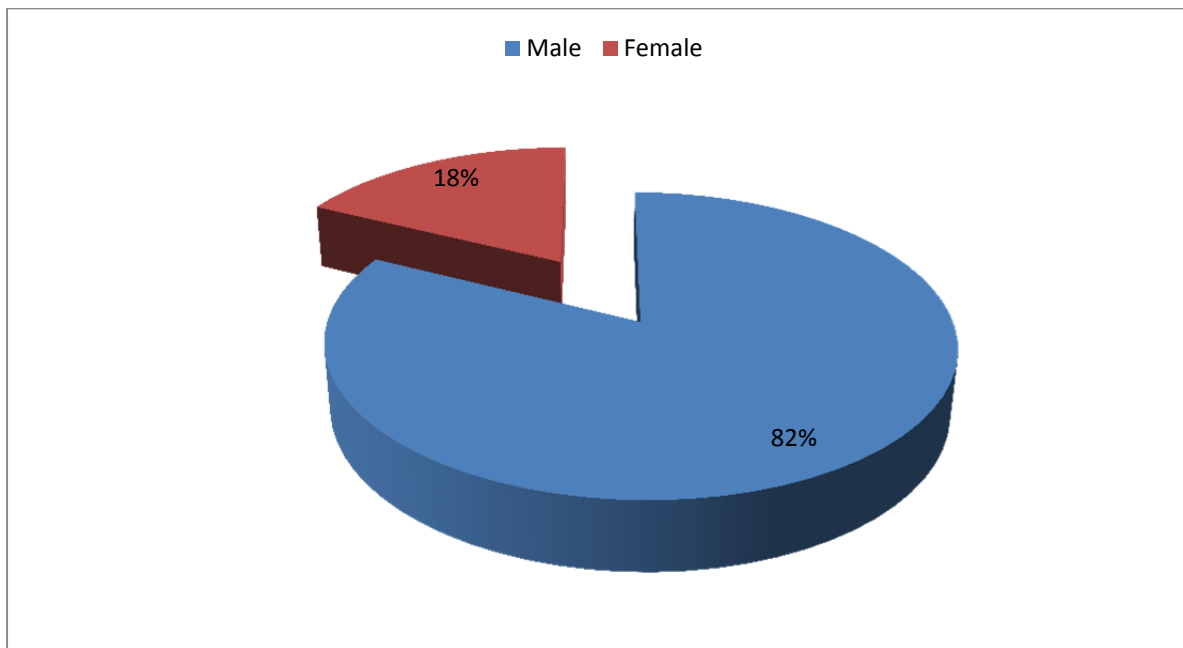


Figure 2: Students' participation based on gender at TRP and SEW 2014



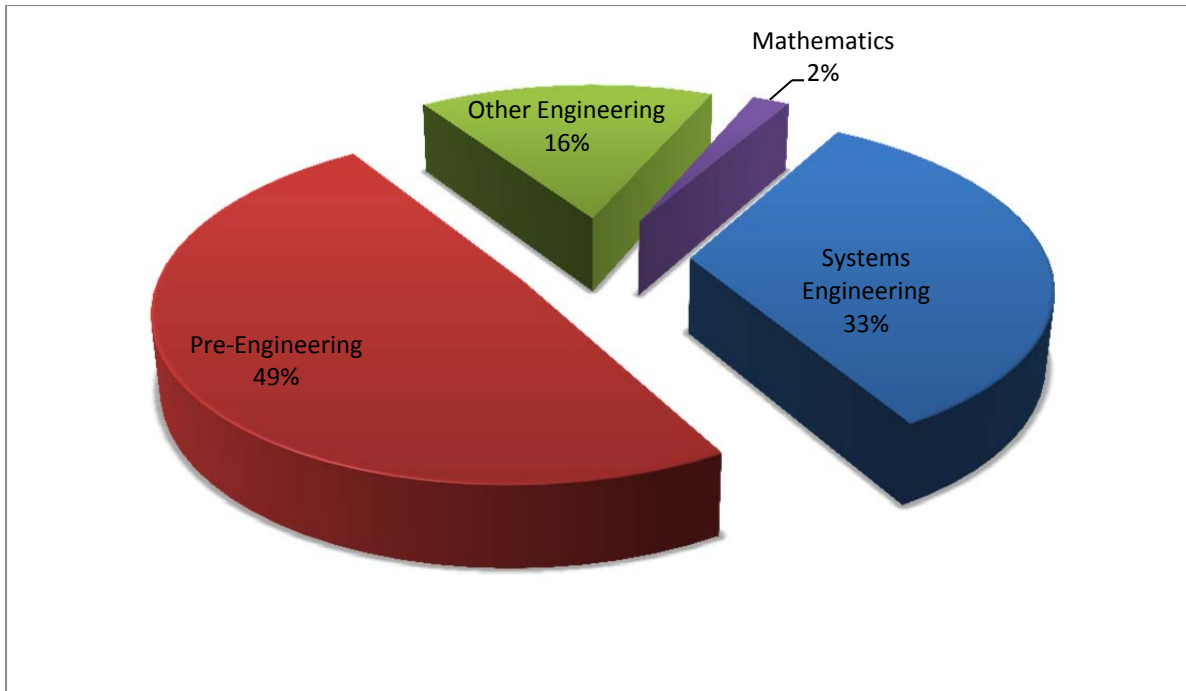


Figure 3: Students' participation based on major at TRP and SEW 2014

### 3.3 Enrichment Activities

In TRP and SEW workshops the students are divided randomly into different groups and a project and its faculty mentor was assigned for each group. The workshop program schedules of TRP and SEW are presented in Table 5 and Table 6, respectively. In these workshops, the students gained different knowledge on life, engineering and career ahead of them as an engineer. Guest speakers were invited for the workshop from different local engineering companies. Table 7 presents the different projects, which are assigned based on the workshops and mentors. The TRP and SEW participants were given the opportunity to conduct research in computer science, mathematics, physics, or engineering under supervision of faculty of the Department. They are encouraged to present their research outcomes at the Department Fall Student Conference and the Spring Lamar Bruni Vergara Academic University Conference at TAMU.

To encourage all TRP and SEW participants, it was promised that upon successful completion of the workshops they will be awarded with the following items:

1. Monetary stipend
2. TI-Nspire CX CAS Handheld Calculator
3. High quality binders
4. Clear pencil pouch
5. Foray blue pencil sharpener
6. Highlighters

7. Writing Pads (8.5 X 11)
8. Blank ink pens
9. Pencils
10. Erasers
11. GB Flash-drives and
12. Mathematical Tool Kit.

Table 5: TRP Summer Workshop 2014 program schedule

Date	Sessions	
	8:30 AM – 12:00 PM	1:00 PM – 4:30 PM
Monday 5/19	Welcome & introduction	Project proposals
	Meeting with mentors	
Tuesday 5/20	Working on projects	Working on projects
Wednesday 5/21	Working on projects	Working on projects
Thursday 5/22	AEP field engineer Mr. Adrian Uresti @ 10:00 AM TxDOT engineer Ms. Rosa E. Trevino @ 11:30 AM	Working on projects
Friday 5/23	Working on projects	Project updates
Monday 5/26	Working on projects (if needed)	Working on projects (if needed)
Tuesday 5/27	USDA at Juarez-Lincoln bridge tour Ms. Murcia Dovalina @ 9:00 AM	Jefferson water plant tour Mr. Toni Moreno @ 1:00 PM-6:00 PM
Wednesday 5/28	Working on projects	Cane engineering Mr. Eddie Garza @ 2:00 PM Rheem plant manager Mr. Luis Portilla @ 3:00 PM
Thursday 5/29	Blue top surveyors – Mr. Henry Mejia @ 10:00 AM	Working on projects
Friday 5/30	Project demonstrations and presentations	Project submittal and awards

The previous workshops faced several problems with the ordering and arrival of parts required for different projects. Based on these problems, in 2014, all the projects were selected long before the workshop dates and the required parts were ordered ahead of time. Therefore, students did not face any problem finished the assigned project. Also, in this workshop, the students' participation was doubled compare to previous workshops.

The two-week TRP and SEW workshop program schedule at TAMIU included the following activities:

- 1 Tours and demonstrations of Jefferson Water treatment plant and USDA at Juarez-Lincoln bridge tour at Laredo, TX
- 2 Discussions with five industry representatives in engineering fields and faculty members

- 3 Work on interdisciplinary engineering projects such as fuel cell design and development, digital clock design, prototyping techniques and Computer Integrated Manufacturing and CNC programming.
- 4 Presenting students achievements at the end of the two-week workshop.

The detail schedule is presented in Tables 5 and 6. Also, Figure 4 to Figure 13 presented different activities and the project details, which were achieved during the TRP and SEW summer workshops 2014.

Table 6: SEW Summer Workshop 2014 program schedule

Date	Sessions	
	9:00 AM – 12:00 PM	1:00 PM – 4:00 PM
Monday 7/21	Welcome & introduction	Project proposals
	Meet with mentors	Work on projects
Tuesday 7/22	Work on projects	Work on projects
Wednesday 7/23	Work on projects	Work on projects
Thursday 7/24	Work on projects	Mr. Luis Portilla - Rheem Mfg Plant @ 3:30 PM
Friday 7/25	USDA tour @ 10:00 AM	Ms. Rosa E. Trevino @ 1:30 PM
Monday 7/28	Mr. Adrian Uresti - AEP @ 10:00 AM	Mr. Peter S. Davis – Planetarium
Tuesday 7/29	Jefferson water plant tour @ 10:00 PM Mr. Toni Moreno - Pico Rd water plant	Work on projects
Wednesday 7/30	Mr. Eddie Garza @ 11:00 AM	Work on projects
Thursday 7/31	Mr. Henry Mejia - Blue Top Surveyors @ 10:00 AM	Work on projects
Friday 8/1	Project demonstrations and presentations	Project submittal and Awards



Figure 4: Final product of Prototyping Techniques with 3D Printer Project

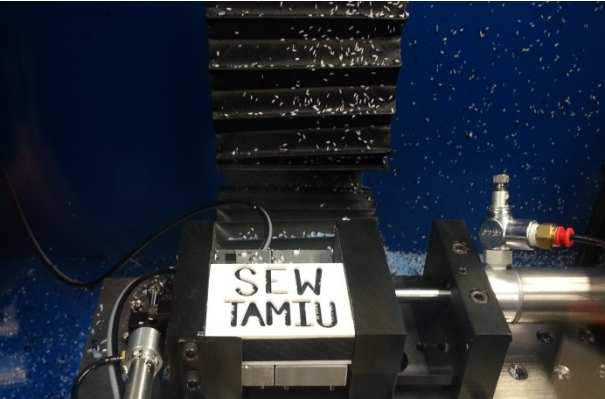


Figure 5: Final product of CNC Milling

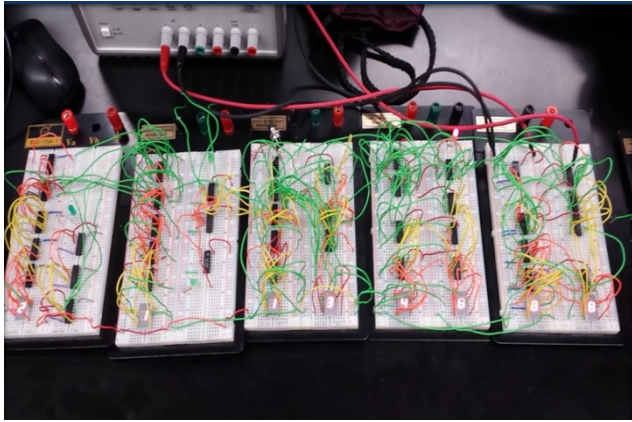


Figure 6: Final product of Digital Clock Design Project



Figure 7: Flight Simulator Project Demonstration

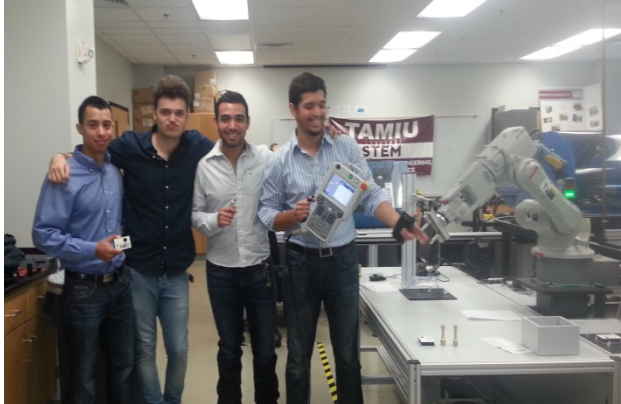


Figure 8: Demopnstration of programming a Motoman Robot



Figure 9: Lego Robot Demonstration



Figure 10: USDA International Bridge Tour, Laredo, TX



Figure 12: Jeffer Water Plant Tour, Laredo, TX



Figure 11: Mr. Adrian Uresti, P.E., a local engineer talked about his experience as an engineer



Figure 13: Ms. Rosa Trevino, P.E., a female engineer talked about her experience as an engineer

Table 7: Projects names and Faculty Mentors

No	Project Names TRP	Mentors
1	Fun with Lego/DVD Rental System Design with Access	Dr. Elias M. Nassar/Dr. Pablo Biswas
2	Prototyping Techniques with 3D Printer	Dr. Namwon Kim
3	Digital Clock Design	Dr. Muhammad Z. Hasan
4	Flight Simulator Design	Dr. Mahmoud T. Khasawneh
5	Hybrid Fuel Cell Design	Mr. Gerardo J. Pinzon
No	Project Names SEW	Mentors
1	Computer Integrated Manufacturing	Dr. Pablo Biswas
2	Prototyping Techniques with 3D Printer	Dr. Namwon Kim
5	Hybrid Fuel Cell Design	Mr. Gerardo J. Pinzon

Skills they learned include teamwork, research, procurement of materials, problem solving and career planning. While working on mathematics and engineering related projects they also got familiar with TAMIU's faculty, students, equipment and other resources available to them. The workshops were enhanced by the supervision, guidance and mentoring by our engineering and mathematics faculty. Each team was assigned a department faculty that oversaw the progress of the project and gave them advice and support. The faculty was paid for their participation.

During the last day of the workshop every team presented their project (see Figures 4-9). Each presentation included a demonstration of the project.

#### **4. Student survey results of TRP and SEW workshops 2014**

A survey conducted at the end of the workshops and out of 51 participants 45 students responded to the survey questions. All the results are presented in Tables 8-9. The results clearly show that the students are very satisfied with the overall workshop. Also, the 40 out of 45 students expressed that they will definitely recommend this workshop to others. Moreover, the results clearly show that the workshop was very well received by the participants. In addition, the average of all the survey questions from all respondents was 4.34 out of 5.0. The student comments on the survey reflected that: 1) speakers should come from different engineering backgrounds as opposed to all from civil engineering; 2) students indicated their desire to spend more time working on the projects; 3) students liked the motivated speakers; 4) students wanted to have more field trips to engineering firms; and 5) students like to know about all the projects involved in the workshop.

The overall feedback question is presented in Appendix A. From the data collected it is obvious that the workshop was successful in encouraging the participants to continue working towards a STEM degree. Overall, the participants indicated they really enjoyed their time in the workshop.

#### **5. Summary and Conclusions**

The STEM-MORE TRP and SYSTEM-SEW summer workshops 2014 (at TAMIU) were great successes. The number of participants was decreased compare to TRP and SEW 2013 but LCC student participation increased from 0 to 4 and 0 to 12, respectively. It is expected that some of the students will transfer to TAMIU in one or two years as the transfer agreement is in place from Fall 2014. Overall, the students had the opportunity to learn several aspects of engineering but not limited to that since one important lessons expressed by most were the opportunity to working in a randomly assigned team, and scheduling meeting times since it was difficult to accommodate around their schedules. Also, the teams learned that procurement of materials and supplies was of great importance. The students had to research materials and not only ensure the correct materials were being order but determine the time of delivery. Many modifications had to be made to ensure completion of the project due to the procurement, purchase and delivery. Finally, from Table 8, it is observed that the students became more interested pursuing their career in STEM field after completing the workshops.

#### **Acknowledgements**

The authors like to show their heartfelt gratitude to the United States Department of Education for funding support, without which these workshops may never be developed. Also, the authors like to thank the reviewers for their careful review to improve the quality of the paper. Also, the authors like to thank Dr. Namwon Kim, Dr. Muhammad Z. Hasan, Dr. Elias M. Nassar, and Ms. Sofia Maldonado, and Ms. Nadia De La Garza of Texas A&M International University, Laredo, Texas, for their support.

Table 8: TRP and SEW Workshops 2014 at TAMIU feedbacks

<b>Please provide your overall rating for the workshop and for the following parts of the workshop</b>					
<b>Questions</b>	<b>Poor (1)</b>	<b>Fair (2)</b>	<b>Good (3)</b>	<b>Very Good (4)</b>	<b>Excellent (5)</b>
Overall rating of this workshop	2%	11%	13%	29%	44%
Overall rating of workshop speakers	0%	2%	20%	40%	38%
Overall rating of workshop field trips	0%	2%	18%	38%	42%
Overall rating of workshop projects	4%	4%	11%	36%	44%
<b>In answering the following questions think about how you felt before and after this workshop about continuing to work towards a STEM degree</b>					
<b>Questions</b>	<b>Not continue (1)</b>	<b>Might not continue (2)</b>	<b>Might continue (3)</b>	<b>Probably will continue (4)</b>	<b>Will continue (5)</b>
Before workshop	0%	0%	13%	27%	60%
After workshop	0%	0%	9%	18%	73%
<b>How valuable did you find each of the following parts of the workshop</b>					
<b>Questions</b>	<b>Not valuable (1)</b>	<b>A little valuable (2)</b>	<b>Somewhat valuable (3)</b>	<b>Valuable (4)</b>	<b>Very valuable (5)</b>
Workshop speakers	0%	2%	13%	20%	64%
Workshop field trips	0%	2%	7%	38%	53%
Workshop projects	0%	0%	13%	31%	56%
<b>How much did you gain because of your participation in the workshop in each of the following areas</b>					
<b>Questions</b>	<b>Nothing (1)</b>	<b>A little (2)</b>	<b>Some (3)</b>	<b>Quite a bit (4)</b>	<b>A lot (5)</b>
Problem solving skills	2%	4%	16%	40%	38%
Confidence in completing projects	2%	4%	9%	29%	56%
Understanding of what engineers do	0%	2%	11%	22%	64%

Table 9: TRP and SEW Workshops 2014-Students commit to transfer

<b>If you are transferring from LCC to TAMIU how much did this workshop help to prepare you for attending TAMIU in the future</b>						
<b>Response</b>	<b>Not sure</b>	<b>Not at all</b>	<b>A Little</b>	<b>Some</b>	<b>Quite a Bit</b>	<b>A lot</b>
	3	0	2	4	3	1

\*See Appendix A for the feedback questions.

## References

- [1]. "National Association for Hispanic Education Hispanic STEM Initiative." Listo America. N.p., 2 Sept. 2009. Web. 25 Nov. 2013.
- [2]. Rafic A. Bachnak PI/Director, Co-PIs: Daniel J. Mott, Rohitha Goonatilake, Runchang Lin, Fernando G. Gonzalez, Pablo Biswas, and Mahmoud T. Khasawneh, "Science, Technology, Engineering and Mathematics Minority Outreach and Retention Enhancement Program (STEM-MORE)," Minority Science and Engineering Improvement Program (MSEIP) Grant, Grant-Award #P120A110067, U.S. Department of Education, Washington, D. C. 20006, Duration: September 30, 2011–October 30, 2014, Fund amount: \$749,120.00
- [3]. Rafic A. Bachnak, Daniel J. Mott, PI/Director, Co-PIs: Rohitha Goonatilake, and **Nadia C. de la Garza**, "Serving Youth in Science, Technology, Engineering and Math at TAMIU (SYSTEM)," Grant-Award # P031C110118, U.S. Department of Education, Washington, D. C. 20006, Duration: September 30, 2013–October 30, 2016, Fund amount: \$450,000.00
- [4]. R. Freeman, A. Fuentes, H. Vasquez, S. Crown, C. Villalobos, R. Wrinkle, O. Ramirez, M. Gonzalez, "Increasing Student Access, Retention, and Graduation Through an Integrated STEM Pathways Support Initiative for the Rio South Texas Region – Year One Activities and Results," *the Proceedings of 117<sup>th</sup> ASEE Annual Conference & Exposition*, 2010.
- [5]. D.S. Cordray, T. Harris, S. Klein, "A Research Synthesis of the Effectiveness, Replicability, and Generality of the VaNTH Challenge-based Instructional Modules in Bioengineering", *Journal of Engineering Education*, 98 (4), pp.335-348 (2009).
- [6]. M. J. Prince, and R. M. Felder, "Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases", *Journal of Engineering Education*, 95(2), 123-138 (2006).
- [7]. Gonzalez, F. and Pinzon, G. J., "A STEM Transfer and Retention Program at Texas A&M International University," T154 - Enhancing the Underrepresented Student Experience, (Indiana Convention Center, Room 123), *the Proceedings of 121<sup>th</sup> ASEE Annual Conference & Exposition*, June 15—18, 2014, Indianapolis, Indiana.
- [8]. Gonzalez, F., Pinzon, G., Gupta, A., and Biswas, P., "A Engineering Discipline Awareness Workshop for Pre-Service STEM," Session: M554 - Beyond Students: Issues of Underrepresentation Among Parents And Professionals, (Indiana Convention Center, Room 123), *the Proceedings of 121<sup>th</sup> ASEE Annual Conference & Exposition*, June 15—18, 2014, Indianapolis, Indiana.
- [9]. Khasawneh, M. T., Bachnak, R. A., Goonatilake, H. R., Lin, R., Biswas, P., and Maldonado, S. C., "Promoting STEM Education and Careers among Hispanics and Other Minorities through Programs, Enrichment, and other Activities," Session: T654 - Preparing Minority Students For Undergraduate And Graduate Research, (Indiana Convention Center, Room 212), *the proceedings of 121<sup>th</sup> ASEE Annual Conference & Exposition*, June 15—18, 2014, Indianapolis, Indiana.
- [10]. R. Bachnak, R. Goonatilake, S. C. Maldonado, and D. J. Mott, "Promoting Student Success in Engineering and Science through Research and Internship Programs," *the proceedings of 120<sup>th</sup> ASEE Annual Conference & Exposition*, June 23 - 26, 2013, Atlanta, GA.
- [11]. A. G. Enriquez, W. Pong, N. M. Ozer, H. Mahmoodi, H. Jiang, C. Chen, A. S. Cheng, "Preparing Underrepresented Students for Success in Engineering: Results and Lessons Learned from Four Years of the Summer Engineering Institute", *ASEE Annual Conference and Exposition*, 2013.
- [12]. Bayer Corporation, "Bayer Facts of Science Education XV: A View from the Gatekeepers-STEM Department Chairs at America's Top 200 Research Universities on Female and Underrepresented Minority Undergraduate STEM Students," *Journal of Science Education and Technology*, 21(23) 2012, 317-324.
- [13]. G. D. Jefferson, S. J. Steadman, T. G. Thomas, and K. Hsiao, "Novel Program for Engineering Student Retention", *the proceedings of 120<sup>th</sup> ASEE Annual Conference & Exposition*, June 23 - 26, 2013, Atlanta, GA.
- [14]. R. Bachnak, L. Runchang, and R. Goonatilake, "Program for Student Retention and Success in Engineering," *the proceedings of 120<sup>th</sup> ASEE Annual Conference & Exposition*, June 23 - 26, 2013, Atlanta, GA.
- [15]. TAMIU Internal Report, "Consortium for Student Retention Data Exchange STEM Retention Survey" 2010-2011.
- [16]. S. H. Gleixner, K. Casey, J. T. Tuberty, P. R. Backer, E. L. Allen, "EXCEED: Excellence in Your Engineering Education Summer Transition," *the proceedings of 120<sup>th</sup> ASEE Annual Conference & Exposition*, June 23 - 26, 2013, Atlanta, GA.



APPENDIX A



Serving Youth in Science,  
Technology, Engineering & Math

**Two-Week Summer Engineering Workshop  
(SYSTEM – SEW)**

July 21- August 1, 2014, 9:00 AM - 4:00 PM

Participants' Feedback Form

Please shade in the circle that represents your answer to each question.

1. Please provide your overall rating for the workshop and for the following parts of the workshop.

	Poor	Fair	Good	Very Good	Excellent
A. Overall rating of this workshop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Overall rating of workshop speakers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Overall rating of workshop field trips	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Overall rating of workshop projects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. In answering the following questions, think about how you felt BEFORE this workshop and how you feel AFTER this workshop about continuing to work towards a STEM degree.

	Your Plans for Continuing to Work Towards a STEM Degree				
	Not Continue	Might Not Continue	Might Continue	Probably Will Continue	Will Continue
A. Before this workshop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. After this workshop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. How valuable did you find each of the following parts of the workshop?

	Not Valuable	Only A Little Valuable	Somewhat Valuable	Valuable	Very Valuable
A. Workshop speakers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Field trips	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Projects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please continue with the questions on the back of this page

4. How much did you gain because of your participation in the workshop in each of the following areas?

	<b>Nothing</b>	<b>A Little</b>	<b>Some</b>	<b>Quite A Bit</b>	<b>A Lot</b>
A. Problem solving skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Confidence in completing projects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Understanding of what engineers do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What did you like best about the workshop?

6. Would you recommend this workshop to other students?

	<b>Yes</b>	<b>No</b>	<b>Not Sure</b>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. How could this workshop be improved?

8. What school(s) are you currently attending?

	<b>LCC</b>	<b>TAMIU</b>
	<input type="radio"/>	<input type="radio"/>

9. If you are transferring from LCC to TAMIU, how much did this workshop help to prepare you for attending TAMIU in the future?

<b>Not Sure</b>	<b>Not At All</b>	<b>A Little</b>	<b>Some</b>	<b>Quite A Bit</b>	<b>A Lot</b>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you for completing this survey.