



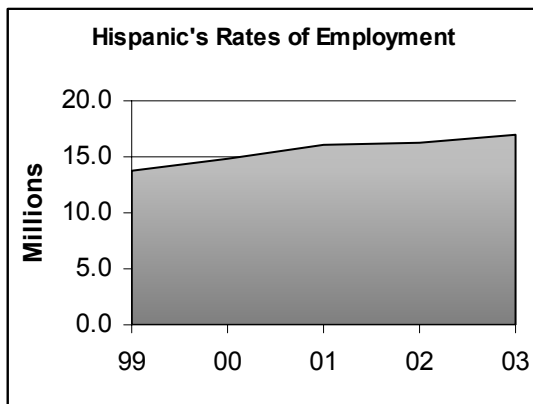
## 1. Objective

The objective of this paper is to present the STEPS program –Science Technology & Engineering Preview Summer Camp for Girls- offered by this institution, as a way to increase the participation of Hispanics in becoming future engineers. The STEPS program is oriented to attract young women to become interested in science and engineering. It is proposed that this same approach can be designed and applied to young Hispanic children. The program permits adaptation to any gender and ethnicity, making it possible in a strategic way to increase Hispanic engineering students. Specific objectives include:

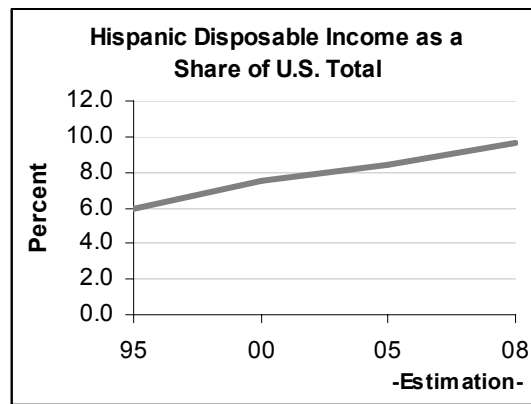
- Understanding of the engineering field
- Understanding of the engineers role in society
- Ability to work in teams and develop leadership skills
- Become familiar with terminologies, labs and machines
- Gain self confidence
- Provide an opportunity to acquire practical experience in science and math

## 2. Why Hispanic students

In the last few decades, the U.S. Hispanic population has been increasing significantly at an average annual rate of 3.93%. Hispanics comprise a group of potential future engineers to increase diversity and fill the expected shortfall of engineers in the next decade. Based on the U.S. Census Bureau, Population Division (2003), Hispanics are 13.72% of the total population in US or 39.9 million people (see appendix I, table 1). They have become the nation’s largest minority, influencing the research and development in companies who are seeking and focusing their strategies in those faster growing consumer groups. This new trend is not only based in the growth of the Hispanic population, but also it is based on their significant buying power, and as a result, a driving force in the economy, politics, and culture.<sup>1</sup>



Source: Bureau of Labor Statistics



Source: University of Georgia

Therefore, in order for US companies to not know Hispanic necessities, preferences and likes, it will become more and more important to have professional engineers who are able to understand the Hispanic culture and, moreover, to transform those necessities, preferences and likes into products and services. In addition, since

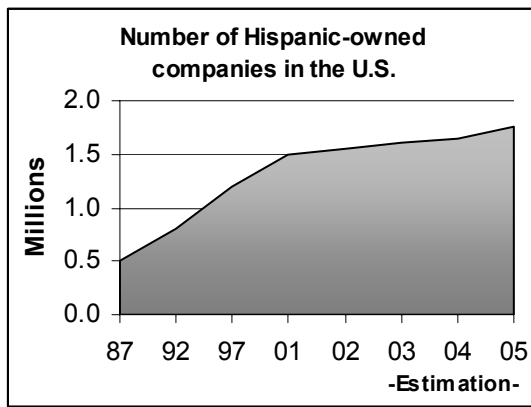
<sup>1</sup> BusinessWeek; March 15, 2004: “Special Report, Hispanic Nation”

Latino entrepreneurs' ranks have jumped by 30% in the last decade, there are engineering entrepreneurial opportunities for Hispanics. US companies can not ignore this demographic trend.

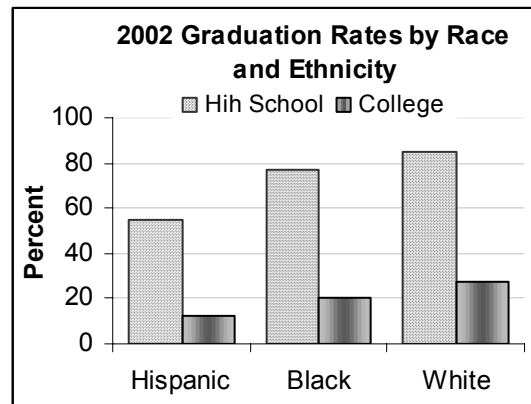
For this reason, US universities must understand and follow the requirements in industry. What are they looking for? What kind of professional do they want? What challenges are they facing?

The principal focus group is the population under 18 years of age, which represents the 34% of the total Hispanic population. This group is composed 50% of children between 5 and 13 ages. The STEPS program is designed for this group. (See appendix 1, table 2).

On the other hand, universities should work closely with K-12 schools in order to increase the graduation rates in ethnicities such as Hispanics, who in 2002 had just a 55% graduate rate. This percentage is lower than the national average of around 82%. These graduation rates of Hispanics have increased in the last years, although they still are below the overall average. For this reason, both institutions (high schools and universities) need to inform students about the different fields of opportunity, inspire them to become educated in the topics critical to those fields and to advise them of high school classes they should take in order to be accepted in the programs of interest.



Source, Internal Revenue Service, Hispan Telligence



Source: Hispan Telligence. U.S. Census Bureau

*“National statistics indicate that Hispanic students are not enrolling nor completing engineering curricula in proportion to their increasing numbers of the population. In order to close this glaring educational gap, more students from Hispanic backgrounds must be motivated, assisted financially and supported with programs to complete their higher education degrees.”<sup>2</sup>*

Census data have shown that Hispanics are now the largest minority in the U.S. However in the fields of technology and science, Hispanics have still a small participation. When combining them with other minorities, they make up only 7 percent of the science and engineering work force. To close this gap and reflect more closely the percentage of Hispanics in the US society, the Hispanic Engineer and Information Technology Editorial estimates that it is necessary to educate more than 250,000 engineers and scientist in the next 10 years as affirmed by.<sup>3</sup>

A study made by the National Science Foundation in Washington, DC in 2000 about Women, Minorities, and Persons with Disabilities in Science and Engineering (available at [www.nsf.gov/sbe/srs/women/start.htm](http://www.nsf.gov/sbe/srs/women/start.htm)) shows that there were 48,600 Hispanic engineers actively working in the U.S., 3.48% out of a total of 1,397,100 engineers. The greatest participation was found in electrical engineering, with 14,000 (28.8%) Hispanic professionals. In the case of Hispanic women, they are increasing their participation in engineer fields, but they are still far away from the levels they could obtain. Only about 10 percent of the Hispanic engineers counted in

<sup>2</sup> Society of Hispanic Professional Engineers –SHPE- foundation, <http://www.shpefoundation.org/>

<sup>3</sup> <http://www.hispanicengineer.com/Editorial/Power%20Hitters.shtml>

the report were women. But the trend is slightly rising if compared with the results obtained 10 years ago when only 5% of the total women professional engineers were Hispanics<sup>4</sup> (see appendix 1, tables 3 and 4).

### **3. WHAT IS STEPS?**

**Science Technology and Engineering Preview Summer camp for girls (STEPS)** is a one-week introduction to the world of technology and engineering. Campers participate in activities that give them a hands-on experience with high-tech equipment and processes. **STEPS** is an opportunity for GIRLS to learn more about what engineers do. Outstanding instructors with extensive backgrounds in engineering, technology and science teach the workshops.

Program activities include manufacturing and flying a radio-controlled airplane. Students also explore science and engineering topics such as physics, chemistry and team building. The camp also schedules a number of activities such as swimming, pizza parties and karaoke. Participants experience dorm life, cafeteria food and learn what it is like to be on a college campus.

#### **Why is STEPS important?**

Women make up half of the population (see appendix 1, table 1) and about 46% of the labor force in all occupations, but only 9% of engineers. Last year there were 120,000 entry-level engineering jobs and only 60,000 engineering graduates. The long-term forecast from the National Academy of Engineering projects that over the next decade, 500,000 engineers will retire and an additional 500,000 new engineering jobs will be created. STEPS is a hands-on, technology-based program that gives girls exposure to manufacturing and technical careers. The camp is an effort to attract more women to careers in engineering, manufacturing, technology and science. The STEPS program is held early enough (7th grade) to influence a student's choices of math, science, and technical courses in middle and high school. These courses help prepare them to enter and succeed in college level engineering programs. The free five-day camp is sponsored by the Society of Manufacturing Engineers Education Foundation and hosted by this Department.

#### **The Story of STEPS**

The Society of Manufacturing Engineers (SME) first conceived of a summer camp for girls in response to National Science Foundation research indicating a need to nurture girls' interest in math and science. Female junior high school students make critical high school curriculum choices that could limit their ability to enter, participate in, and succeed in an engineering program in college. Intervention at this vulnerable point could set them on a course for a seamless transition to college engineering programs. SME envisioned a Science Technology and Engineering Preview Summer (STEPS) camp for girls as a one-week introduction to the exciting, fun, challenging, and rewarding world of science, technology and engineering.

The first STEPS camp was held in 1997 in Wisconsin. The program was replicated in Minnesota in the summer of 2000. In 2002, STEPS camps extended to Michigan, and Illinois. The SME Education Foundation will continue to partner with corporations, foundations and academic institutions to expand the STEPS program throughout North America. The program remains a popular one as overall trends in applications and enrollment testify (see appendix II, table 1 and 2).

The SME concept had been to partner three colleges/universities to provide summer camps such as STEPS for 7<sup>th</sup> grade students and then to provide the opportunity for a follow-on camp at the 10<sup>th</sup> or 11<sup>th</sup> grade level at a third school.

#### **Activities**

The camp is designed to achieve an appropriate balance between a total of 27 separate technical, developmental, and recreational activities. Selected technical activities focus around scientific principles and their respective engineering applications to create useful products. The primary curriculum running through the program, its centerpiece, is the manufacture of radio-controlled airplanes. Each girl manufactures her own airplane in a

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<sup>4</sup> [http://www.diversitycareers.com/articles/pro/febmar03/fod\\_hispanics.htm](http://www.diversitycareers.com/articles/pro/febmar03/fod_hispanics.htm)

variety of laboratories to produce its components, and then works in an assembly lab to build the airplane. Classes in physics, chemistry, and electricity serve as ‘consultant services’ to the airplane manufacturer. Applied mathematics is built into the session. A favorite recreational and developmental activity occurs when the students get together with experienced radio control pilots to fly their planes at FLY NIGHT (see appendix II, table 3).

**Evaluation**

STEPS addresses the problem of an insufficient number of women with adequate science and math preparation to enter college engineering programs nationally. This translates directly to a shortage of female engineering professionals. STEPS’ purpose is to introduce young women to the field of engineering early enough to influence their choice of courses that will determine their readiness for engineering and science college programs upon graduation from high school. To increase the proportion of women pursuing careers in engineering, science, and technology, the program has three objectives:

- To increase the number of girls selecting the appropriate math and science courses in middle and high school which prepare them for the study of engineering, technology, and science in college.
- To increase the proportion of women entering engineering, technology, and science in college.
- To enhance women’s appreciation of engineering, technology, and science disciplines.

The SME Education Foundation funds STEPS program evaluation methodology. Reporting is provided annually on the results of individual programs as well as the consolidated effort. The Longitudinal Study follows campers from completion of the 6<sup>th</sup> grade until four years past their expected high school graduation date. Data will be collected from both participants and a control group. The most recent evaluation results are reported at Stout where the campers were asked to relate to three statements on a five-point Likert scale varying from strongly disagree to strongly agree. The percentages reporting that they strongly agreed with the statement indicates that campers have already elevated their perceptions of themselves in math, science, or technology fields as they leave the camp at the end of the week. Using a paired t-test, the following general results, demonstrate significantly increased perceptions.

	<u>Pre-camp</u>	<u>Post-camp</u>
<i>It is okay for me to work in the field of Science</i>	60%	70%
<i>It is okay for me to work in the field of Math</i>	62%	68%
<i>It is okay for me to work in the field of Engineering</i>	59%	72%

Post-camp ratings demonstrate also a significant ( $p<.001$ ) increase in science and math interests after participation in a STEPS camp. In a pre-and post-test of the STEPS campers, campers indicate an increase of 7.3 to 7.6 for their perception of self-esteem, an increase of 7.4 to 7.7 for their perception of self-efficacy, and an increase of 6.7 to 7.0 for their perception of their interest in math and science. The percentage of girls seriously considering engineering or science as a career possibility almost doubles, and the number of those who had initially ruled it out is greatly reduced.

The major findings of the survey appear to be that STEPS alums are taking elective math and science courses at a higher rate than others. This fact serves to validate the effectiveness of STEPS in achieving its important intermediate objective of providing inspiration to girls to adequately prepare for engineering, science, and technical careers.

**4. Impact**

Recently this institution contacted 7 of 25 Hispanic girls who participated in past years of the STEPS program. They were asked some questions about their impressions at the summer camp and how the program has influenced them (see appendix III, table 1).

The results show that in general all girls are continuing to take math and science classes after the STEPS camp and are planning to take them in the next years. A high percent (86%) said that the program stimulated them in

these fields and just one girl said that, because her father teaches science, she was already interested in this field. They agreed that in general they liked almost everything about the program. Just 29% said that maybe some courses were boring and 14% that they did not like the fact of been divided in groups, they would prefer to have the opportunity to know the other girls better.

100% said that they decided to attend the camp by themselves because they were interested in the program. All of them knew about the STEPS camps from their schools. 43% of the girls are right now very interested in science fields; they said they really like their science and math classes.

As Hispanics, they did not feel any discrimination, they felt comfortable with the other girls and some of them are still in contact with some of the girls. 71% said that it would be nice to find something related to their countries or origins such as music or food.

All of them would like to participate in future programs. Indeed one of them who is entering 11<sup>th</sup> grade next year is planning to attend another engineering camp next summer, due to her interest in study this at college.

## **5. National replication opportunities**

Because STEPS is so highly regarded nationally, the Society of Manufacturing Engineers-Education Foundation has initiated several camps based on this model. Similar camps now exist in Michigan at Grand Valley State University and University of Detroit Mercy, and in Minnesota. Bradley University in Illinois initiated a Caterpillar-sponsored STEPS camp for both boys and girls this summer. SME-EF hopes to extend the program nationwide, encouraging more young people, particularly women and minorities, to explore career opportunities in manufacturing, engineering, science and technology.

The purpose is to encourage other institutions to adopt the program and target it to Hispanic students at an early age;. Although there have been significant gains in the number of Hispanics enrolled in college, the percentage of the total is still small. Seems to be that the participation of Hispanics in education decreases at each increased level of education. Applying a STEPS program for Hispanic students early enough in their education may help stimulate interest in engineering, an awareness of potential future careers and an increase in the number of Hispanic students in college engineering programs.

## **6. Testimonials**

Lindsay S., 12, says she had "little" interest in engineering before STEPS, but a lot of interest after the camp. "I never realized there was so much stuff you could do in engineering. I thought engineering was way above my head, like you had to be a brain in math. It's a field that's opened up to me now because of this camp."

"STEPS is the best camp that I have ever been to. Not only do you get to stay in a dorm, but also the accommodations are great. It's all free and just for GIRLS! On top of all that, you get to learn a lot about science and technology. Some of the fabulous stuff included is ... chemistry, plastics, physics, machining, and so much more. That's right, you get to learn stuff while having a totally great time. Tell your parents about this camp; you will never regret it. Then you won't get sent to an educational camp where you probably won't have as much fun as you would here."

Excerpt from a camper's webpage

"I had a great time at STEPS camp. We did a ton of fun things, played games, made things with plastic, swimming, classes on physics, eating ice cream everyday, and last but not least, building airplanes. Our airplanes were so cool. We went and flew our planes at fly night. We stayed in dorm rooms, too. STEPS was 5 of the funniest (sic) days in my life. I hope more girls get to experience STEPS next week and next year."

Excerpt from a camper's webpage

## Appendix I

**Table 1. Hispanic Population in USA  
July 1, 2000, 2001, 2002, and 2003**  
(Numbers of Resident population)

<b>TOTAL</b>	<b>July 1, 2003</b>	<b>%</b>	<b>July 1, 2002</b>	<b>%</b>	<b>July 1, 2001</b>	<b>%</b>	<b>July 1, 2000</b>	<b>%</b>
<b>Total USA</b>	<b>290,809,777</b>	<b>100.00%</b>	<b>287,973,924</b>	<b>100.00%</b>	<b>285,093,813</b>	<b>100.00%</b>	<b>282,177,754</b>	<b>100.00%</b>
<b>Male</b>	143,037,260	49.19%	141,533,390	49.15%	140,008,546	49.11%	138,456,499	49.07%
<b>Female</b>	147,772,517	50.81%	146,440,534	50.85%	145,085,267	50.89%	143,721,255	50.93%
<b>Total Hispanics</b>	<b>39,898,889</b>	<b>13.72%</b>	<b>38,488,318</b>	<b>13.37%</b>	<b>37,061,662</b>	<b>13.00%</b>	<b>35,650,103</b>	<b>12.63%</b>
<b>Male</b>	20,599,101	51.63%	19,851,803	51.58%	19,096,693	51.53%	18,347,611	51.47%
<b>Female</b>	19,299,788	48.37%	18,636,515	48.42%	17,964,969	48.47%	17,302,492	48.53%

Source: U.S. Census Bureau, Population Division, population estimates program.

**Table 2. Hispanic Population in USA  
July 1, 2000, 2001, 2002, and 2003**  
(Numbers of Resident population)

<b>TOTAL Male/Female</b>	<b>July 1, 2003</b>	<b>%</b>	<b>July 1, 2002</b>	<b>%</b>	<b>July 1, 2001</b>	<b>%</b>	<b>July 1, 2000</b>	<b>%</b>
<b>All ages</b>	<b>39,898,889</b>	<b>100.00%</b>	<b>38,488,318</b>	<b>100.00%</b>	<b>37,061,662</b>	<b>100.00%</b>	<b>35,650,103</b>	<b>100.00%</b>
<b>Under 18 years</b>	<b>13,588,755</b>	<b>34.06%</b>	<b>13,194,429</b>	<b>34.28%</b>	<b>12,786,937</b>	<b>34.50%</b>	<b>12,416,309</b>	<b>34.83%</b>
<b>Under 5 years</b>	4,157,922	30.60%	4,024,173	30.50%	3,866,328	30.24%	3,734,124	30.07%
<b>5 to 13 years</b>	6,806,786	50.09%	6,637,883	50.31%	6,450,681	50.45%	6,240,182	50.26%
<b>14 to 17 years</b>	2,624,047	19.31%	2,532,373	19.19%	2,469,928	19.32%	2,442,003	19.67%

Source: U.S. Census Bureau, Population Division, population estimates program.

**Table 3. Hispanic Male Population in USA**  
**July 1, 2000, 2001, 2002, and 2003**  
 (Numbers of Resident population)

<b>TOTAL Male</b>	<b>July 1, 2003</b>	<b>%</b>	<b>July 1, 2002</b>	<b>%</b>	<b>July 1, 2001</b>	<b>%</b>	<b>July 1, 2000</b>	<b>%</b>
All ages	20,599,101	100.00%	19,851,803	100.00%	19,096,693	100.00%	18,347,611	100.00%
Under 18 years	6,950,486	33.74%	6,750,679	34.01%	6,548,459	34.29%	6,369,937	34.72%
Under 5 years	2,123,388	30.55%	2,055,239	30.44%	1,975,811	30.17%	1,909,011	29.97%
5 to 13 years	3,481,676	50.09%	3,394,635	50.29%	3,297,951	50.36%	3,189,084	50.06%
14 to 17 years	1,345,422	19.36%	1,300,805	19.27%	1,274,697	19.47%	1,271,842	19.97%

Source: U.S. Census Bureau, Population Division, population estimates program.

**Table 4. Hispanic Female Population in USA**  
**July 1, 2000, 2001, 2002, and 2003**  
 (Numbers of Resident population)

<b>TOTAL Female</b>	<b>July 1, 2003</b>	<b>%</b>	<b>July 1, 2002</b>	<b>%</b>	<b>July 1, 2001</b>	<b>%</b>	<b>July 1, 2000</b>	<b>%</b>
All ages	19,299,788	100.00%	18,636,515	100.00%	17,964,969	100.00%	17,302,492	100.00%
Under 18 years	6,638,269	34.40%	6,443,750	34.58%	6,238,478	34.73%	6,046,372	34.95%
Under 5 years	2,034,534	30.65%	1,968,934	30.56%	1,890,517	30.30%	1,825,113	30.19%
5 to 13 years	3,325,110	50.09%	3,243,248	50.33%	3,152,730	50.54%	3,051,098	50.46%
14 to 17 years	1,278,625	19.26%	1,231,568	19.11%	1,195,231	19.16%	1,170,161	19.35%

Source: U.S. Census Bureau, Population Division, population estimates program.

Appendix II

Table 1. STEPS Program 2003

YEAR	Total Applications to MN (A)	Total Applications to UST (B)	(B) / (A)	Number of participants (C)	(C) / (B)
2000	425	235	55.29%	172	73.19%
2001	751	479	63.78%	160	33.40%
2002	760	354	46.58%	155	43.79%
2003	450	450	100.00%	164	36.44%

Table 2. STEPS Enrollment by ethnicity 2003

Ethnicity	Week 1	Week 2	Week 3	Week 4	Total	Participation
African-American	5	4	7	5	21	12.8%
Asian	4	2	3	5	14	8.5%
Hispanic	3	1	3	1	8	4.9%
Native American	0	1	2	2	5	3.0%
Not filled in	2	1	3	4	10	6.1%
<b>Total campers from underrepresented groups</b>					<b>58</b>	<b>35.4%</b>

Table 3. STEPS Activities

Technical (37%)	Developmental (38%)	Recreational (25%)
Electricity Lab	Author Presentation and	Swimming
Chemistry Lab	Book Signing	Mississippi Hike
Physics Lab	Diversity Training	Open Gym
CAD Lab	Career Planning	Picnics
Machining Lab	Fieldtrip to the Bakken	Karaoke Party
Plastics Lab	Museum	Games
Robotics	Team Building	Pizza Party
Assembly Lab	Radio Control Airplane	Skits about Camp
Flight Simulation	Flying-FLY NIGHT	Crazy Olympics
Personal Webpage	Campus Tour	
Design	Graduation	



Appendix III

Table 1. STEPS camp follow up survey of Hispanic STEPS students  
June 2004

Questions	
<b>1. Did you take science and math last year?</b>	
Yes	100%
No	0%
<b>2. Are you going to take them next year?</b>	
Yes	100%
No	0%
<b>3. Did the STEPS camp stimulate your interesting in science and math?</b>	
Yes	86%
No	14%
<b>4. What was the most interesting experience at the camp?</b>	
Airplane	71%
Plastics	14%
To be on campus	14%
<b>5. What was the least interesting experience at the camp?</b>	
Some courses were boring	29%
To be divided in groups	14%
I liked everything	57%
<b>6. Why did you decide to go to the camp?</b>	
I was interested	100%
My parents told me	0%
Other	0%

Questions	
<b>7. What are you most interested in now?</b>	
Science	43%
Sports	29%
Don't know	29%
<b>1. Are you doing any activity outside school?</b>	
Sports	43%
Acting classes	29%
Nothing	29%
<b>9. Did you feel comfortable with the other girls at the camp?</b>	
Yes	100%
No	0%
<b>10. Would it be different for you if there were other Hispanics as instructors or coordinators at the camp?</b>	
Not really, but would be nice	71%
Don't now	29%
<b>11. Would you be interested in attending another camp in the future?</b>	
Yes	100%
No	0%