Abstract
The mission of the UPRM Chemical Engineering department is to develop professionals and outstanding citizens that are capable of solving society problems especially those related to chemical engineering. For many years the department has been very successful in many areas. It is one of the main sources of Hispanic chemical engineers, especially females, in the United States. Also in 1996 the department made the commitment to pursue the establishment of a Ph.D. program. This goal was attained in December 1999 when the Puerto Rico Board of Higher Education approved the program. Another area that the department has been very successful is in encouraging students to pursue a graduate degree. This effort also improved significantly during the last nine years with the implementation of the Sloan Fellowship Program and other initiatives. As will be seen there was a substantial increase in the number of students that are pursuing Ph.D. degrees.

Keywords
Sloan Foundation, Feeder Program, Mentoring

1. Introduction
The mission of the UPRM Chemical Engineering department is to develop professionals and outstanding citizens that are capable of solving society problems especially those related to chemical engineering. For many years the UPRM Chemical Engineering department has been very successful in many areas (Hernández-Maldonado). For example, it is one of the main sources of Hispanic chemical engineers, especially females, in the United States. The department has approximately 700 students of which 65% are females. In the 1990’s over 100 undergraduate (B.Sc.) and 10 graduate (MS/ME) students graduated per year. The Graduate Program has 30-40 students. Also in 1996 the department made the commitment to pursue the establishment of a Ph.D. program. This goal was attained in December 1999 when the Puerto Rico Board of Higher Education approved the program. The Ph.D. program officially started with three students in January 2000.

Another area that the department has been very successful is in encouraging students to pursue a graduate degree. This effort also improved significantly during the last nine years with the implementation of the Sloan Fellowship Program and other initiatives (Colucci and Brian). As will be seen below in figure 1 there was a substantial increase in the number of students that are pursuing Ph.D. degrees. In addition, the students enrolling in undergraduate research at UPRM has achieved a healthy steady state, which provides students with excellent exposure and culture to encourage them to pursue doctoral degrees. Also, tables and graphs are provided showing the final product of these efforts, doctoral degrees awarded to UPRM undergraduate alumni.
2. Results

In 1997 the Chemical Engineering department at UPRM was awarded a three year Sloan Foundation Grant in order to improve the efficiency of the department related to identifying and encouraging students to obtain Ph.D. degrees in chemical engineering. The program is presently requesting funding for its four phase (three years per phase). The long term objective is that some of these students will continue to an academic career. A key component of the proposal was to establish a mentoring program and culture in the department in order to guide and motivate the students to pursue a Ph.D. degree in Chemical Engineering. This program along with other Initiatives has been very successful in involving undergraduate students in a wide variety of activities that provide them a broader perspective in deciding their careers. For example, notice in the next figure the explosive increase and sustained number of undergraduate students participating in undergraduate research at the Chemical Engineering department of UPRM. On average over 130 students enroll in this undergraduate research per year. Notice that the CHEM E department graduates approximately 100 students per year. Therefore, most of UPRM-CHEM E students are exposed to undergraduate research. It should be mentioned that approximately 10 to 12 professors have undergraduate research sections. This corresponds to approximately 10 “mentored” students per year. This activity is closely tied to the “reward” that is provided to these students by co-sponsoring their participation at the American Institute of Chemical Engineers National Convention poster and CHEM E car competitions. As mentioned later over 100 undergraduates attend this conference presenting between 30 to 40 posters. Also, in order to participate in this convention they are required to present their posters at the local UPRM – CHEM E Annual Symposium normally organized one month before the National Convention. There is also a poster competition at the local symposium. This symposium is attended by over 250 participants from industry and government agencies. It should be mentioned that all the logistic related to the National Convention are organized by the AICHE student chapter.

It is important to mention that in addition to undergraduate research (InQu 4998), UPRM CHEM E students also enroll aggressively in other alternative learning and teaching opportunities (ALTO) such as COOP (InQu 4995), Summer Internships (InQu 4036) and Special Problems (InQu 5995). This is shown in figure 2. Notice the increased preference of CHEM E students towards undergraduate research opportunities.

The above and other activities resulted in an undergraduate research culture that led to a high success rate in motivating students to pursue Ph.D. degrees as proposed in the original Sloan Foundation proposal. This is shown in figure 3 and supporting data in Table 1. The figure shows the number of students admitted to doctoral programs per year (ADMITTED) and proposed per year targets line. Also, it shows the PhDs awarded (PhDs Degrees) and those that left PhD programs (Left PhD). These are shown in bar graph form. The awarded PhDs do not include those from the recently established UPRM PhD program. The line graphs show the accumulated
PhD degrees (Accum PhDs), number of PhD students in the pipeline (PhD in Pipeline) and accumulated target (Proposed – PhD). The latter two were corrected by subtracting the PhD graduates from the accumulated Admitted and proposed, respectively. The accumulated admitted (PhD in the Pipeline) were also corrected for those that left the PhD programs. Notice that after eight years 64 UPRM alumni (33 females) continue successfully toward their doctoral degrees compare to 33 that were proposed. Also, notice that only eleven (6 females) left the doctoral programs during that period. In addition, twenty two UPRM alumni (13 females) will have obtained their doctoral degrees during the same period. These numbers include nine students that have or will be presenting their thesis in 2006. They do not include UPRM doctoral degrees granted during that time.

Table 1 – Supporting Data for Figure 3

<table>
<thead>
<tr>
<th>Year</th>
<th>Admitted</th>
<th>Left PhD</th>
<th>PhD in Pipeline</th>
<th>Proposed</th>
<th>PhDs</th>
<th>PhDs Accum</th>
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<td>2</td>
<td>31</td>
<td>4</td>
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<tr>
<td>1999</td>
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<td>0</td>
<td>26</td>
<td>6</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>0</td>
<td>27</td>
<td>6</td>
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</tr>
<tr>
<td>2002</td>
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<td>0</td>
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<tr>
<td>2003</td>
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<td>0</td>
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<td>6</td>
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<td>2004</td>
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<td>2005</td>
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<tr>
<td>2006</td>
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<td>0</td>
<td>28</td>
<td>6</td>
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</tbody>
</table>

Other accomplishments that were obtained and/or activities that students participated in recent years that were sponsored mostly by the Sloan Foundation were:

i) American Institute of Chemical Engineers National Student Poster Session, November 2003, San Francisco, California. Over one hundred students attended the conference. Thirty six posters were presented. Five won awards.

ii) American Institute of Chemical Engineers National Student Poster Session, November 2004, Austin, Texas. Over one hundred students attended the conference. Thirty five posters were presented. Approximately ten won awards.

iii) American Institute of Chemical Engineers National Student Poster Session, November, 2005, Cincinnati, Ohio. Over one hundred students attended the conference. Twenty nine were presented. Approximately ten won awards.

Also, during the last six years the local (@ Mayaguez) Merck, Sharp and Dohme sponsored Environmental, Health and Safety Symposium was used as a showcase and preview (practice) of the posters that are presented at the AICHE National Student Poster Session. This symposium is attended by over 250 participants from industry and government agencies.

An important component for the success of a feeder program is the establishment of closed collaborations with doctoral granting institutions. However, the establishment of formal Alliances with doctoral granting programs was not implemented. Based on our experiences during phases II and III doctoral granting Universities have very effective Summer Internship programs and prefer to continue a more informal approach. They seem to be interested in the Sloan Fellows on an individual basis rather than as a group. Also they seem to prefer working on a personal contact basis with a professor rather than through Institution alliances. It should be mentioned that during the last three years excellent informal
collaborations have been established with several institutions including Michigan State, Iowa State University, University of Iowa, University of Notre Dame, University of Kentucky, University of Pittsburgh, Ohio State University, Mississippi State University, University of South Florida – Tampa, Virginia Tech, University of Connecticut @ Storrs, University of South Carolina and Texas A&M. Most of them were visited by Dr. Colucci and vice versa as part of the establishment of close collaborations for the recruitment of potential graduate students. Other institutions with historic strong and effective recruitment efforts at UPRM CHEM E include University of Wisconsin – Madison, University of Michigan – Ann Arbor and Purdue University. Most of these universities have summer research experiences for undergraduates programs which are used very effectively for the graduate program recruitment efforts. These networking activities will be continued for phase IV. Also, as expected, as the number of UPRM alumni accepted at doctoral granting institutions increases (including Summer REU participants) the interest of those institutions in our students increases. Our alumni are also excellent ambassadors of our program at those institutions.

3. Conclusions

During the last nine years the Sloan Foundation sponsored feeder program at the UPRM Chemical Engineering department have been instrumental in increasing the number of undergraduate students that pursue doctoral degrees. During this period 64 UPRM alumni (33 females) continue successfully toward their doctoral degrees compare to 33 that were proposed. Also, only eleven (6 females) left the doctoral programs during that period. In addition, twenty two UPRM alumni (13 females) will have obtained their doctoral degrees during the same period. These numbers include nine students that have or will be presenting their thesis in 2006. It should be emphasized that in addition to the contribution and effect of the Sloan Foundation to this success story, equally important was the commitment and alignment of the department administration and professors in these efforts. They always supported, mentored and provided alternative learning and teaching opportunities (ALTO) to our undergraduate students thus encouraging and preparing them to consider and pursue graduate school as a realistic option after graduation.

Acknowledgments

This initiative was supported by the Sloan Foundation and the University of Puerto Rico – Mayagüez campus. Also, special recognition to the UPRM CHEM E department student chapters who organize entirely the participation of the students at the AICHE national conventions. In addition, recognition should be given to the mentors who provide professional guidance to students during their undergraduate research and other courses and the department administration for supporting these activities.

References


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