Strengthening the STEM Pipeline through an Intensive Review Program for Math Placement Testing

Amelito Enriquez
Cañada College, Redwood City, CA

Abstract:

Although many California Community College students from underrepresented groups enter college with high levels of interest in science and engineering, their levels of preparation for college-level work, especially in math and engineering, are so low on average that the majority of them drop out or change majors even before taking transfer-level courses. To facilitate the transition of these students into transfer-level math, science, and engineering courses, Cañada College, a federally designated Hispanic-serving institution in the San Francisco Bay Area, developed an intensive math placement test review program. The Summer Math Jam is a two-week intensive mathematics program designed to improve students' preparation for college-level math courses. Implementation of the program over the last two years shows success in improving student performance in the math placement test, and success in creating a sense of community among program participants. An analysis of student academic performance in subsequent semesters show significantly higher success and retention rates among Math Jam participants compared to nonparticipants. Since the implementation of Math Jam, enrollments in STEM courses have increased significantly, with a higher rate of increase among minority students. The success of Math Jam in improving the participation, retention, and success of minority STEM students has led to the development of the Mini-Math Jam – a shorter, one-week version of Math Jam that is offered a week prior to the beginning of the fall semester, and during the winter break. The Mini-Math Jam has also been successful in helping students improve their placement scores, and preparing them for subsequent math courses they take.

1. Introduction

Community colleges serve as the gateway to higher education for large numbers of students in the U.S., especially minority and low-income students. Yet for many students, the community college gateway does not lead to success. According to a study of community colleges in California, only one in four students wanting to transfer or earn a degree/certificate did so within six years.[1] The completion rates for African American and Hispanic students are even lower, with only 15% of African American students and 18% of Latino students completing a degree or certificate within six years, compared to 27% of Caucasian students, and 33% of Asian students.

For Science, Technology, Engineering, and Math (STEM) fields, lower success and retention rates for minority students are observed at both community college and university levels resulting in underrepresentation of minority groups in these professions. For instance, while comprising almost 25% of the U.S. population, African Americans and Latinos make up less than 7% of the individuals with B.S. or higher-degrees in the science and engineering fields.[2] Strategies that have been proven effective in increasing the retention and success of minority students in science and engineering include mentoring programs,[3,4] introducing context in

introductory courses,[5] alternative instructional strategies such as collaborative and interactive learning,[6] and summer bridge programs.[7,8]

In 2008, Cañada College, a Hispanic-Serving community college in Redwood City, CA, was awarded a Minority Science and Engineering Improvement Program (MSEIP) grant by the US Department of Education. The project, entitled Student On-ramp Leading to Engineering and Sciences (SOLES), aims to increase the participation, retention, and success of underrepresented and educationally disadvantaged students interested in pursuing careers in STEM fields. Among the strategies developed for this project is the Summer Math Jam – a two-week intensive mathematics program designed to improve students' preparation for college-level math courses. This paper summarizes the results of the implementation of the Math Jam and its one-week version, the Mini-Math Jam, over the last two years.

2. Incoming Student Interest and Level of Preparation for Engineering

Cañada College is a member of the California Community College System, and is one of three colleges in the San Mateo County Community College District (SMCCCD). It is one of only two federally-designated Hispanic Serving Institutions in the San Francisco Bay Area. The College opened in 1968, and is located in Redwood City, California. During the 2009-2010 academic year, the College enrolled 11,566 students. The student body is genuinely multi-cultural with Hispanic students as the largest single group at 39.2%; white students comprise 33.3%, Asians 8.6%, African-Americans 3.8%, Filipinos 3.6%, Pacific Islanders 1.7%, American Indian/Alaska Natives 0.4%, other 9.5%.[9] Like all of the California Community College System institutions, Cañada is an open-enrollment institution, designed to welcome students of all ages and backgrounds to higher education.

Students Who:	Pre-algebra	Algebra	College Algebra	Trigonometry
Took the Math placement Test	47.1%	28.0%	17.0%	7.9%
Declared majors in STEM fields	32.9%	26.7%	23.8%	16.6%
Declared majors in Engineering	20.7%	32.0%	27.2%	20.1%

Table 1. Summary of April 2006 to April 2010 Math Placement Test results for 6300 students of all majors, 697 students who declared STEM majors, and 169 students who declared engineering majors.

At Cañada College, an important factor that contributes to low degree completion and transfer rates for STEM majors can be attributed to the inadequate preparation of community college students to take college-level mathematics courses. Table 1 summarizes the Math Placement test results of Cañada College students from April 2006 to April 2010. Among all students who took the placement test, 75.1% placed into either pre-algebra or algebra. For students who declared a STEM major, the results were only slightly better, with 59.6% of students placing into either pre-algebra or algebra. Even among those who declared engineering as their major, over 50% of students placed into one of these two remedial math courses. The results of these math

placement tests have serious and adverse consequences for these students' timely completion of lower-division courses, and subsequent transfer to a university.

The performance on the math placement test is correlated with student ethnicities. Table 2 summarizes the ethnic distribution of the math placement test results for students who declared a STEM major. Among the biggest ethnic groups, African American students have the lowest percentages of students placing into trigonometry (6.3%), and the highest percentages of students placing into pre-algebra (71.9%), followed by Mexican Americans with 12.5% placing into trigonometry, and 39.1% placing into pre-algebra.

Ethnic Group	Pre-algebra	Algebra	College Algebra	Trigonometry	% of Total
African American	71.9%	15.6%	6.3%	6.3%	4.6%
Asian American	20.8%	22.9%	33.3%	22.9%	6.9%
Caucasian	22.9%	31.4%	24.8%	21.0%	30.1%
Mexican American	39.1%	26.2%	22.1%	12.5%	38.9%
Other	30.9%	24.3%	26.5%	18.4%	19.5%
All Ethnicities	32.9%	26.7%	23.8%	16.6%	100.0%

Table 2. Ethnic distribution of Math Placement test results for students who declared majors in STEM (Data from April 2006-April 2010; 697 students).

Although nationally, interest in science and engineering is lower for Latino, African American, and Native American students compared to other ethnic groups,[10] this is not the case at Cañada College. Table 3 summarizes the percentages of students taking the placement test, students declaring STEM majors, students declaring an engineering major, and students who transferred to a four-year school as an engineering major (2006-2010) for the four largest ethnic groups – Mexican Americans, Caucasian, Asian Americans, and African Americans. Although Mexican Americans represent only 37.2% of all the students who took the placement test, they represent 38.9% of students who declared a STEM major, and 46.2% of students who declared engineering as their major. Despite such a high interest in engineering among Mexican Americans, they represented only 19.4% of all students who transferred to a four-year school as engineering majors from 2006-2010. These data clearly represent a much lower rate of retention and transfer for Mexican Americans compared to Caucasian and Asian Americans.

The first two years of typical engineering curricula require two years of courses that include sequences of courses in calculus and physics. A student who starts at College Algebra has an

additional one and a half years of mathematics (College Algebra, Trigonometry and Pre-calculus) on top of the two-year sequence of lower-division transferable courses. A student who starts at Pre-algebra has an additional two and a half years (Pre-algebra, Algebra, College Algebra, Trigonometry and Pre-calculus) of mathematics before they are ready to take Calculus. Hence, 39.1% of Mexican Americans and 71.9% of African American students will need at least four years at Cañada College before transferring. For many of them with family obligations and no family support, this is simply too long of a career path.

Percentage of Students Who:	Mexican American	Caucasian American	Asian American	African American	Other
Took the Math placement Test	37.2%	30.2%	5.7%	6.4%	20.5%
Declared majors in STEM fields	38.9%	30.1%	6.9%	4.6%	19.5%
Declared majors in Engineering	46.2%	27.8%	4.1%	3.6%	18.3%
Transferred as Engineering majors	19.4%	21.3%	30.6%	0.9%	27.8%

Table 3. Summary of the ethnic distribution of Cañada College students who took the placement test (April 2006-April 2010; 6,300 students), who declared STEM majors (697 students), who declared majors in engineering (169 students), and who transferred to a four-year school as engineering majors (2006-2010, 108 students) for the four largest ethnic groups.

3. The Summer Math Jam

The Summer Math Jam at Cañada College was developed to help students who have expressed interest in pursuing engineering and other STEM majors but placed low in the sequence of math courses.

The Summer Math Jam was developed with the following program goals:

1. Help students progress faster through Cañada's math sequence to enable them to transfer to a 4-year university earlier or to complete an associate's degree earlier.
2. Increase students' awareness of the tools, skills, and resources they need to be successful college students.
3. Develop a community of learners among program participants.

Both the 2009 and the 2010 Summer Math Jams were held from 9:00 a.m. to 3:00 p.m., Monday through Thursday during a two-week period that coincided with Cañada College's break between the end of spring semester and the beginning of the summer term. Morning and afternoon sessions were devoted to studying math either in groups or individually using MyMathTest,[11] an online system developed by Pearson Education for developing math placement tests and short

math refresher programs. Workshops related to resources and skills needed for college success were offered in the afternoon. As a result of a mid-program focus group that indicated that students wanted to devote more time to studying math, and less on these workshops, the afternoon college success workshops were made optional for the second week of the 2009 Math Jam and the entire 2010 Math Jam.

Table 4 summarizes the demographics of Math Jam participants in the last two years. The number of participants more than doubled, from 50 in 2009 to 129 in 2010. For both years, a majority of participants were female, with Hispanic being the predominant ethnic group. In 2009, 50% of the participants were the first in their family to attend college compared to 42.9% for 2010.

Demographics	**2009**	**2010**
Number of Participants	50	129
Gender		
Female	64.7%	55.9%
Male	35.3%	44.1%
Ethnicity		
African American	5.9%	3.6%
Asian/Pacific Islander	2.9%	10.7%
Caucasian	20.6%	24.1%
Hispanic	61.8%	58.0%
Native American/Alaskan Native	0.0%	1.8%
Other	8.8%	7.1%
First in Family to Attend College?		
Yes	50.0%	42.9%
No	50.0%	57.1%

Table 4. Demographics of Summer Math Jam participants.

Table 5 is a summary of the results of the last two years of implementation of Math Jam. Even though the number of participants more than doubled from 50 in 2009 to 129 in 2010, the completion rates remained about the same, 84% for 2009, and 83% for 2010. Among students who have pre- and post-program placement test scores, the percentage of students with higher post-program scores decreased slightly from 94% in 2009 to 91% in 2010. However, the percentage of students who placed into at least the next higher math level after Math Jam increased from 64% in 2009 to 71% in 2010. These results are significantly better than the 56% "jump rate" for participants of a similar two-week summer math bridge program at Pasadena City College.[12]

Summer Math Jam Results	2009 Math Jam	2010 Math Jam
Number of Participants	50	129
Number Completed	42	107
Completion Rate	84%	83%
With Pre- and Post-Test Scores	33	42
Improved Test Scores	94%	91%
% Placed into Higher Level	64%	71%

Table 5. Summary of Math Jam results in 2009 and 2010.

Question	Pre-Program	Post-Program	Difference (Post - Pre)
How would you rate your math study skills? 1=poor, 5=excellent	3.064	3.635	0.571***
How would you rate your confidence in math? 1=not at all confident, 5=very confident	3.155	3.619	0.463**
How effective are you at time management? 1=not at all effective, 5=very effective	3.698	3.813	0.114
To what extent do you feel that you have supportive relationships with students at Cañada? 1=not at all supportive, 5=very supportive	3.766	4.127	0.361*
To what extent do you feel that you have supportive relationships with tutors at Cañada? 1=not at all supportive, 5=very supportive	3.657	4.377	0.720***
How interested are you in studying STEM? 1=not at all interested, 5=very interested	3.778	3.825	0.047

* The difference is statistically significant ($p < 0.050$).

** The difference is statistically significant ($p < 0.010$).

*** The difference is statistically significant ($p < 0.001$).

Table 6. 2010 Math Jam Student Survey Results.

To evaluate the success of Math Jam in achieving its secondary goals of increasing student awareness of tools, skills and resources needed to succeed in college, pre- and post-program student surveys were administered. Table 6 summarizes student responses to the pre- and post-program surveys. Statistically significant improvements were observed in the following areas: student rating of their math study skills, student rating of confidence in math, and student perceived supportive relationships with other students, and tutors. The improvement in student

perception of effectiveness in time management, and the increase in their interest in studying STEM are not statistically significant.

4. Academic Performance of Math Jam Students

To truly evaluate the success of the Math Jam program in helping students achieve their academic goals, the success of the program participants beyond the two-week duration of the program needs to be monitored. To this end, the performance of the 2009 Math Jam participants in the math courses they took in fall 2009 was monitored. Table 7 is a comparison of the performance of three groups of students: 2009 Math Jam students who advanced at least to the next math class during math jam, 2009 MJ students who did not advance to the next math class during the program, and all students in fall 2009 math courses. The performance measures compared are the retention rate and success rates in the math courses. The last two columns of Table 7 show that 2009 Math Jam students when taken as a group have higher retention and success rates (75.7% and 62.2%, respectively) compared to all math students in the semester (74.5% and 50.5%, respectively). The third column of Table 7 shows that despite having already skipped at least one math class, the MJ students who advanced significantly outperformed all the math students in the semester, with much higher retention rate (84.2% versus 74.5%), and success rate (68.4% versus 50.5%). This is a significant result that addresses some initial concern among math faculty that skipping a math course might result in students being less prepared to be successful in the more advanced math course.

	MJ Students who Advanced (N=19)	MJ Students who did not Advance (N=18)	All MJ Students (N=37)	All Math Students (N=1515)
Retention Rate	84.2%	66.7%	75.7%	74.5%
Success Rate	68.4%	55.6%	62.2%	50.5%

Table 7. Performance of 2009 Math Jam students in fall 2009 math courses.

One of the primary reasons for the low degree-completion and transfer rates among community college students is the low persistence rates, i.e., students not continuing from one term to the next.[13] Another indication of better performance of 2009 Math Jam participants is their persistence from one semester to the next. Table 8 is a comparison of the persistence rates of Cañada students and 2009 Math Jam participants. Over the last several years, a study of first time fall semester Cañada students shows persistence rates of 55% for the following spring semester, 38% for the fall of the following year and 32% for the spring semester of the second year. For the 2009 Math Jam participants, the corresponding persistence rates were 93% for spring 2010, and 76% for fall 2010. At the time of writing this paper, the spring 2011 enrollments had not been completed. With much higher persistence rates, the degree-completion and transfer rates for these students are expected to be much higher as well.

Two important variables that are commonly believed to strongly influence the retention of students are academic and social integration as articulated by Tinto's model of college student persistence/withdrawal based on these variables.[14,15] It is often assumed that academic and social

integration are more difficult to achieve in the community college setting because of the lack of time to participate in institutional activities that facilitate such integration.[16] To enhance opportunities for the creation of academic and social integration, an approach that is of increasing popularity in community colleges is the use of learning communities. Learning communities are small groups of students who take thematically linked classes that are often interdisciplinary in order to enhance academic and social integration of students, and strengthen their cognitive skills.[17] There are many studies showing that learning communities can significantly increase student retention, especially in developmental courses.[17,18,19,20,21,22]

	All First Time Students	2009 Math Jam Attendees
Fall of Yr 1	100%	100%
Spring of Yr 1	55%	93%
Fall of Yr2	38%	76%
Spring of Yr 2	32%	?

Table 8. Comparison of persistence rates of all first time Cañada students and 2009 Math Jam participants.

The success of Math Jam in increasing the retention rate among its participants may be analyzed in framework of Tinto's academic and social integration model. The intense two-week, 6 hours per day format of Math Jam provides an ideal context for academic and social integration among its participants, and may prove to be as effective as semester- or year-long learning communities programs that are commonly adopted in community colleges to improve student retention. Math Jam's informal instructional format of individual and group study sessions creates a relaxed and supportive learning environment. Additional opportunities for social/non-academic interactions arise during snack and lunch breaks, and during optional afternoon workshops that explore students' strengths and weaknesses, as well as skills, resources and attributes important for college success. This creates a sense of integration and connectedness that is evident in the results of participant responses to the pre- and post-program surveys – statistically significant increases to student perceived supportive relationships with Math Jam tutors, and with other participants.

5. Mini-Math Jam

Because of the success of the summer Math Jam, and student demand for it, Cañada College decided to offer Mini-Math Jam sessions. Mini-Math Jam is a one-week version of Math Jam offered a week before the beginning of the semester, and is designed to help students prepare for taking a math class during the semester. It was offered once in January 2010, the 2010 Winter Mini-Math Jam, and in August 2010, the 2010 Summer Mini-Math Jam, and the results are summarized in Table 9. The completion rates for the two MMJ sessions are comparable, 87% for the winter, and 91% for the summer session. However, the percentage of students who placed into higher math class is much lower for the winter MMJ than the summer MMJ. This is because most of the students for the winter MMJ are not first time students who are trying to

improve their initial math placement results but are returning or continuing students whose primary purpose in attending the MMJ is to prepare for the math courses that they are taking the following spring semester. At the time of writing this paper, another MMJ is scheduled for January 10-14, 2011, and student interest continues to rise, as more than 130 students have applied to participate.

Mini-Math Jam Results	**2010 Winter MMJ**	**2010 Summer MMJ**
Number of Participants	87	74
Number Completed	76	67
Completion Rate	87%	91%
With Pre- and Post- Test Scores	22	31
% Placed into Higher Level	36%	61%

Table 9. Summary of the results for the 2010 winter and 2010 summer mini-Math Jam.

6. Effect on STEM Enrollment

The primary goal of the US Department of Education Minority Science and Engineering Improvement Program (MSEIP) grant that funds Math Jam is to increase the number of minority students majoring in science and engineering, and transferring to four-year institutions as STEM majors. To determining the success of math jam in achieving this goal, enrollment trends in transfer-level math, science, and engineering courses are analyzed.

	Minority		**Non-Minority**	
	Fall 2009	Fall 2010	Fall 2009	Fall 2010
Engineering	133.3%	200.0%	46.3%	80.5%
Mathematics	46.3%	46.3%	20.3%	9.3%
Biological Sciences	36.1%	28.6%	14.2%	27.9%
Chemistry	178.1%	90.6%	95.2%	74.6%
Physics	22.2%	55.6%	-12.5%	7.8%

Table 10. Comparison of percentage increase in enrollment in selected STEM areas for minority and non-minority students for fall 2009 and fall 2010. All percentage changes are with respect to the program base year of fall 2008.

The success of the Math Jam and Mini-Math Jam programs has contributed to significant enrollment increases in transfer-level courses in math, sciences and engineering. Table 10 shows the percentage increases in enrollment in STEM courses among minority and non-minority students. Since fall 2008, the base year of the Math Jam program, enrollments in transfer-level courses in math, engineering, biological and physical sciences have increased significantly. The

percentage increase in the number of minority students enrolled in these courses is significantly higher than the percentage increase for the non-minority groups. The biggest differences in rates of increase between minority and non-minority student enrollments are observed in engineering (200% for minority students vs. 80.5% for non-minority students), mathematics (46.3% for minority students vs. 9.3% for non-minority students), and physics (55.6% for minority students vs. 7.8% for non-minority students). It should be noted that among the STEM areas, engineering, math and physics courses have higher prerequisite math courses beyond College Algebra. Enrollment in transfer-level courses in these subject areas is highly dependent on timely completion of the required sequence of math courses, a direct effect of successful participation in Math Jam. Over the same period, overall college enrollment increased by 8.4%, significantly lower than the increase for transfer-level STEM courses.

7. Conclusion

The first two years of implementation of Math Jam have been successful in achieving the program's primary goal of helping students progress faster through Cañada's math sequence. A majority of students who have pre- and post-program math placement test scores placed into at least the next higher math course. This results in a reduction of the cost and time for these students to complete their degrees and/or the lower-division courses they need to transfer to a four-year institution.

Math Jam has also been successful in increasing students' awareness of college success tools and skills, and in creating a community of learners that felt comfortable at Cañada. Academic performance of Math Jam participants in semesters following their participation in the program was significantly better both in the areas of retention and success rates, indicating the effectiveness of the program. Even more remarkable is the significantly higher persistence rate of Math Jam participants, with a one-year persistence rate that is double that of the College's rate among first-time students based on historical data. The improved persistence may be attributed to the enhanced academic and social integration experienced by Math Jam participants brought about by an intense and focused yet informal instructional atmosphere that fosters a sense of community among program participants, and a feeling of connectedness to the program staff and the College as a whole. These results indicate that shorter programs may be as effective as, or even more effective than traditional semester-long or year-long learning communities in creating opportunities for student engagement and immersion into the college experience in order to increase student persistence.

Math Jam was designed primarily to help students who have expressed interest in a STEM field but have low levels of preparation for taking college-level math courses as indicated by their math placement test results. Due to high interests in STEM and low placement test scores, participation in the program was higher among minority students compared to non-minority students. This higher rate of participation among minority students and the success of Math Jam in enhancing their academic performance are reflected in the increase in enrollment in transfer-level STEM courses since the program was initiated. Although enrollments in STEM transfer-level courses have increased for all student groups and for all STEM areas, the rates of increase are significantly higher among minority students, especially for engineering, mathematics, and

physics where minority student enrollment has traditionally been lower due to inadequate high school preparation in math.

The success of Math Jam has prompted Cañada College to institutionalize the program. Beyond the duration of the three-year Minority Science and Engineering Improvement Program grant that funds the Math Jam, the College will continue to implement and improve the program and contribute to the strengthening of the STEM educational pipeline for students from underrepresented groups. As more students choose the community college pathway towards careers in science, technology, engineering, and mathematics, more programs like Math Jam need to be developed in order to produce the well-educated work force that is needed to ensure that the United States remains the premier place in the world for innovation.

Acknowledgements

This project was supported by a grant from the US Department of Education through the Minority Science and Engineering Improvement Program (MSEIP, Award No. P120A080080).

Bibliography

1. Shulock, N., & Moore, C. (2007). *Rules of the game: How state policy creates barriers to degree completion and impedes student success in the California Community College.* Sacramento: Institute for Higher Education Leadership and Policy.
2. National Science Foundation (2007). Women, minorities, and persons with disabilities in science and engineering: 2007, Arlington, VA: National Science Foundation, Division of Science Resource Statistics.
3. National Science Foundation (2004). Women, minorities, and persons with disabilities in science and engineering: 2004, Arlington, VA: National Science Foundation, Division of Science Resource Statistics.
4. Goodman Research Group (2002). Final report of the women's experiences in college engineering (WECE) project, Cambridge, MA.
5. Davis, C-S. & Finelli, C.J. (2007), Diversity and Retention in Engineering, *New Directions for Teaching and Learning*, v2007, n111, p63-7.
6. Derlin, R.L. & McShannon, J.L. (2000), Faculty and Student Interaction and Learning Styles of Engineering Undergraduates, Retrieved May 10, 2008 from http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/16/89/1d.pdf.
7. Goldberg, J. & Sedlacek, W. (1996), *Summer Study in Engineering for High School Women*, Maryland University, College Park, Maryland.
8. Pantano, J. (1994), *Comprehensive Minority SEM Programs at Santa Fe Community College*, Paper presented at the Annual International Conference of the National Institute of Staff and Organizational Development on Teaching Excellence and Conference of Administrators, Austin, TX, May 22-25, 1994.
9. California Community Colleges Chancellor's Office (n.d.). Retrieved December 22, 2010 from Chancellor's Office Data Mart website: http://www.cccco.edu/ChancellorsOffice/Divisions/TechResearchInfo/MIS/DataMartandReports/tabid/282/Default.aspx

10. National Science Board (2000). *Science and Engineering Indicators 2000* (No. NSB-00-1), National Science Foundation, Arlington, VA.
11. Pearson Education (2008). *MyMathTest*. Pearson Education. Retrieved January 7, 2010 from http://mymathtest.com/login_mmt.htm.
12. Pasadena City College (n.d.), Summer Math Jam: Preparing Students for Success, Retrieved October 9, 2009 from http://www.achievingthedream.org/_pdfs/_strategyinstitute07/PreparingStudentsforSuccess.pdf .
13. O'Banion, T. (2010). The Completion Agenda: To What End? Emerging Philosophy Shifts Focus from Student Access to Success, *Community College Journal*, v81 n2 p44-47.
14. Tinto, V. (1993). *Leaving College: Rethinking the causes and cures of student attrition* (2nd ed.). Chicago: University of Chicago Press.
15. Tinto, V. (1975). Dropout from Higher Education: A Theoretical Synthesis of Recent Research, *Review of Education Research*, V45, p89-185.
16. Karp, M., Hughes, K., & O'Gara, L. (2010). An Exploration of Tinto's Integration Framework for Community College Students, *Journal of College Student Retention: Research, Theory & Practice*, v12 n1 p69-86.
17. Visher, M., Schneider, E., Wathington, H., & Collado, H. (2010). Scaling up Learning Communities: The Experience of Six Community Colleges, National Center for Postsecondary Research. Teachers College, Columbia, Retrieved December 19, 2010 from http://www.eric.ed.gov/PDFS/ED509307.pdf
18. Tinto, V., Goodsell-Love, A., & Russo, P. (1994). *Building Learning Communities for New College Students: A Summary of Research Findings of the Collaborative Learning Project*. University Park, PA: Pennsylvania State University, National Center on Postsecondary Teaching, Learning, and Assessment.
19. Smith, B., & MacGregor, J. (2009). Learning Communities and the Quest for Quality, *Quality Assurance in Education: An International Perspective*, v17 n2 p118-139.
20. Barnes, R., & Piland, W. (2010). Impact of Learning Communities in Developmental English on Community College Student Retention and Persistence, *Journal of College Student Retention: Research, Theory & Practice*, v12 n1 p7-24.
21. Weiss, M., Visher, M., & Wathington, H. (2010). *Learning Communities for Students in Developmental Reading: An Impact Study at Hillsborough Community College*, National Center for Postsecondary Research. Teachers College, Columbia University. Retrieved December 19, 2010 from http://www.eric.ed.gov/PDFS/ED510961.pdf
22. Arnett, A., & Van Horn, D. (2009). Connecting Mathematics and Science: A Learning Community that Helps Math-Phobic Students, *Journal of College Science Teaching*, v38 n6 p30-34.

Biographical Information

Amelito Enriquez is a professor of engineering and mathematics at Cañada College. He received his PhD in Mechanical Engineering from the University of California, Irvine. His research interests include technology-enhanced instruction and increasing the representation of female, minority and other underrepresented groups in mathematics, science and engineering.