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The IMSA© PROMISE: Igniting and Nurturing Diverse STEM Talent

Adrienne Coleman

Illinois Mathematics and Science Academy, acoleman@imsa.edu

Barb J. Miller

Illinois Mathematics and Science Academy, bmiller@imsa.edu

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**The IMSA[®] PROMISE:
Igniting and Nurturing Diverse STEM Talent**

By Adrienne Coleman and Barbara J. Miller

“Your PROMISE Program has been the life-line to extend and enhance the knowledge base for these students...by providing them with the time to develop seemingly outlandish ideas or tease their brains with the “what if” possibilities...you are making such a huge difference in the lives of these inner city youth who, otherwise, would not be privy to this level of academic exposure until much later on in their academic pursuits” (McNeal, 2013).

What educator writes such impassioned comments about an enrichment program designed to ignite and nurture talented underrepresented and underserved students? These are the heartfelt and sincere words of a Science Department Coordinator at Robert A. Black Magnet School in Chicago, Illinois about the Illinois Mathematics and Science Academy[®]'s highly successful pipeline program, IMSA PROMISE, which ignites and nurtures diverse STEM talent.

The Achievement Gap

For years, we have grappled with the effects of the “Achievement Gap,” which has been defined in various ways: (a) the National Assessment of Educational Progress (2011) defined it as the “observed, persistent disparity of educational measures between the performance of groups of students, especially groups defined by socioeconomic status (SES), race/ethnicity and gender;” (b) the National Education Association (2013) focused on differences between the scores of students with different backgrounds (ethnic, racial, gender, disability, and income) on large-scale standardized tests, adding that test score gaps often lead to longer-term gaps,

including high school and college completion and the kinds of jobs students secure as adults; and (c) the Great Schools Partnership (2013) emphasizes “any significant and persistent disparity in academic performance or educational attainment between different groups of students, such as white students and minorities or students from higher-income and lower-income households.”

The GSP further defines the achievement gap as having any significant and persistent disparity in academic performance or educational attainment between different groups of students, such as white students and minorities or students from higher-income and lower-income households.

Haycock (2001) indicated that “to increase the achievement levels of minority and low-income students, we need to focus on what really matters: high standards, a challenging curriculum, and good teachers.” Limited research has been conducted on achievement gaps among students who perform at advanced levels; existing studies provide evidence that the educational system consistently short-changes certain populations of students capable of reaching high levels of academic performance. Research suggests that high achieving Black students may be attending schools with less challenging learning experiences and fewer resources. After 5th grade, the gap between students with higher initial achievement increased quickly while the gap between those with lower initial achievement either increased marginally or shrank. It was found that the achievement gap between low achievers tended to increase between grades 3 and 8; only a few districts succeeded in raising the test scores and closing the achievement gaps of underrepresented minority groups (Plucker, Burroughs & Song, 2010, p.2).

Middle School: STEM Education

In their work on closing the mathematics achievement gap in high poverty middle schools, Balfanz and Byrnes (2006) indicated that the United States is falling behind other developed nations in mathematics achievement and that “the students who are falling behind are

from predominately high poverty and/or high-minority areas....For many high-poverty students the middle grades are a period in which achievement gaps in mathematics become achievement chasms” (p. 143). The same may be said for science education.

In its position statement on science education for middle level students, The National Science Teachers Association (2013) recommended a strong emphasis on middle level science education, noting that “the middle school years, grades 5 through 9, are a time of tremendous physical, emotional, and cognitive change for students” (para.1). It also is a pivotal time in their understanding of and enthusiasm for science. Research indicates students may never “find their way back to science” if educators don’t capture their students’ interest in and enthusiasm for science by grade 7 (NSTA, 2013).

We concur with the Position Statement of Multicultural Science Education by The National Science Teachers Association, “we believe all children can learn and be successful in science and our nation must cultivate and harvest the minds of all children and provide the resources to do so” (NSTA, 2000). It is imperative that schools,

... provide science education programs that nurture all children academically, physically and in development of a positive self- concept; children from all cultures are to have equitable access to quality science education experiences that enhance success and provide the knowledge and opportunities required for them to become successful participants in our democratic society; and curricular content must incorporate the contributions of many cultures to our knowledge of science (NSTA, 2000).

IMSA PROMISE

Background

The Illinois Mathematics and Science Academy (IMSA) serves diverse student populations through PROMISE (Providing Opportunities for Math and Science Enrichment) Program, a pipeline program featuring pre-enrichment activities in mathematics, science, and technology designed to discover and develop diverse STEM talent in underrepresented learners in grades 5-9 from under-resourced school districts and socio-economically disadvantaged communities. These populations are often characterized by high dropout rates, low levels of secondary education, and poor economic opportunities that combine to yield high crime rates and unstable living conditions (Barton & Coley, 2009).

Since 1995, IMSA PROMISE has served those gifted, disadvantaged and/or minority middle school students challenged by the combination of economic inequities, academic program deficiencies, and social pressures that define them as "at risk" for future academic success as a direct outcome of their inclusion in these demographic groups.

We believe that introducing these programs early in students' educational experiences to be most effective. These students require access to programs that (a) encourage excellence as opposed to avoiding failure, (b) place a value on learning and education, and (c) create an engaging and relevant learning environment. IMSA PROMISE is designed to meet these three criteria, and is geared to stimulate interest and develop skills in STEM, and challenge and motivate participants toward high achievement. In addition, IMSA PROMISE assists students with overcoming academic deficiencies and prepare for advanced study in secondary school programs, whether or not they matriculate at IMSA. Generally, long-term systemic instruction is necessary for PROMISE students to become proficient in knowledge and skills that are the prerequisites to success in an academically challenging high school program.

Pipeline of Five Programs

IMSA PROMISE consists of five programs which provide, “options for students to further develop their interests and talent, and prepare for advanced study in STEM” (Marshall, McGee, McLaren & Veal, 2011) and feature activities that are curriculum-based and develop skills in problem-solving, communication, collaboration, and making connections between the core subject areas of science, math, and literature. Students participating in the two-week residential summer camp (SEAMS) at the Illinois Mathematics and Science Academy are exposed to on-campus life and have the opportunity to meet current IMSA students and learn first-hand of the joys and challenges of attending a specialized secondary school in science, technology, engineering and mathematics (STEM).

Research indicates that students begin to identify with subjects as middle school students and if their interest does not emerge by high school, the likelihood of them pursuing a STEM career is less than those who identify with math and science in middle school and study these subjects in high school (Singh, Granville, & Diak, 2002). Beginning in fifth grade, students with an interest and talent in science and mathematics are identified and referred to IMSA PROMISE, either through student self-identification or by parents or educators. The level of engagement and exposure to curriculum is enhanced within the five unique PROMISE programs that are offered annually, each presenting a slightly different method and manner to attract, motivate, and engage students:

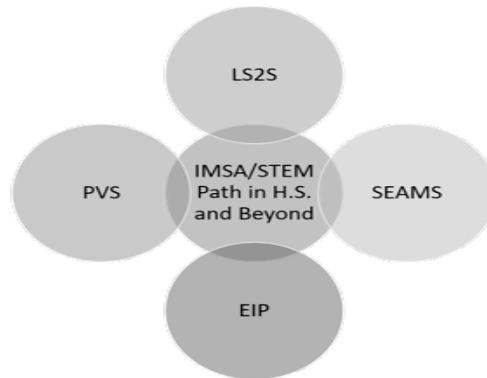
- **Grades 5-8: one day excursion, Project School Visit (PSV).** Provides hundreds of students annually with an excursion to IMSA’s campus with a “day in the life of an IMSA student,” in which they are able to interact with academically high achieving students from similar backgrounds and cultures, engage in inquiry-based and problem-centered learning experiences, and perform science experiments in the laboratories.
- **Grades 5-8: semester program, Leading Students to Success (LS2S).** Provides approximately 100 students during their critical decision-making years with an introduction to inquiry-based learning. This cross-age cooperative learning program features mentorships, tutoring, and Illinois Scholastic Aptitude Test (ISAT) preparation.

Alumni PROMISE participants who are current IMSA students serve as program leaders. *“I gained knowledge that will stay with me a life time. It helped me enrich my problem solving. It helped me understand science and math more than I ever did before. The people have been so nice and helpful in these steps of discovering myself. It has been a joy to attend!”*(LS2S participant)

- **Rising 9th graders: summer program, Summer Enrichment for Academics in Mathematics and Science (SEAMS).** Provides 70 rising 9th graders with a two-week summer residential camp experience on IMSA’s campus. Students explore the core subjects of mathematics, science, and English around a central theme and are engaged in hands-on activities that are focused on real world problems, such as energy and conservation. *“I learned how to take a leadership role in groups...my math and science understanding is amazing...I gained lots of confidence from the IMSA program.”* (SEAMS participant)
- **Grade 9: Early Involvement Program (EIP).** Provides 40-50 students with discovery-based and collaborative research activities and preparation for the Scholastic Assessment Test (SAT) during ten Saturday sessions throughout the school year. Students develop skills in research, decision-making, and self-motivation skills; receive tutoring; and study mathematics, science, literature, and wellness. *“I learned more about the SAT’s. I mastered many lessons in geometry, I learned about Fermi numbers and the importance of vocabulary. I improved my skills at writing lab reports and learned more about how forensic specialists do their jobs (Law and Order is NOT real). I got better working in groups and as a team, and I got all new friends.”*(EIP participant)
- **Current IMSA students: PROMISE and Excel Extension Program (PEEP).** Provides a personalized approach to the retention of underrepresented (URP) and at-risk students who have not been exposed to as much mathematics and science, but have demonstrated potential and talent. Students who participated in the PROMISE and Excel programs are invited to become members of PEEP, which meets on Sunday evenings during the academic year. Most sessions include 30 minute interactions with IMSA URP alumni, and each involve 2 hours spent with IMSA faculty members—1 hour science; 1 hour mathematics. Those who are struggling at IMSA are connected to alumni who faced similar challenges, but are now successful adults. Thus, PEEP serves to enhance the self-confidence of URP students, thereby minimizing the gifted student achievement gap. At-risk IMSA students are provided with additional academic and emotional support to enable their academic success and retention. As upperclassmen, PROMISE and Excel alumni serve as tutors and mentors for sophomores, and this in turn, provides opportunities for leadership and mentoring, and PEEP increases the retention of these URP students. *“PROMISE programs have taught me so much and make me feel as though I am making a difference. I love the feeling of being able to help a student understand a new concept and see the spark of excitement during a lab. Diversity in the classroom creates so much more potential and PROMISE has made me realize the importance of varying opinions and perspectives”* (Kenzo Esquivel, IMSA Alum)

Goals and Objectives

PROMISE is an integrated, cooperative learning pre-enrichment program that includes PSV, LS2S, SEAMS, EIP and PEEP with the following goals and objectives:



Short-term goals. Include the following: (a) provide enriching academic experiences that create academic growth and stimulate interest in STEM, expose students to subject content in mathematics, science, and language arts utilizing problem-centered, inquiry based, and collaborative, integrative methods; (b) facilitate interaction with and instruction from high school students who are interested and gifted and talented in science and math (IMSA students), who are also of the same culture and background; (c) provide a residential experience similar to IMSA’s secondary school, demonstrating student life on campus; (d) enhance critical thinking skills and improve test-taking skills for the ISAT and in anticipation for taking the SAT; (e) assist students in overcoming deficiencies in academic preparation necessary to attend and succeed in any advanced secondary school program and increase their competitiveness if they choose to apply to IMSA; (f) provide continuously challenging learning experiences in STEM through programs that are part of the IMSA pipeline and; (g) provide leadership programs and support the retention of PROMISE students currently attending IMSA.

Long-term goals. Include these: (a) increase the number of students from underrepresented populations who apply to and are accepted for admission into secondary STEM programs, such as IMSA; (b) increase the number of students, especially those from underrepresented populations, who pursue college majors and careers in STEM.

Objectives. PROMISE Students will experience the following benefits: (a) increase their understanding of inquiry-based and problem-centered learning; (b) demonstrate greater mastery of critical thinking skills; (c) express greater interest in STEM subjects and experiences; (d) demonstrate increased academic achievement in science, mathematics, and writing skills; (e) show improvement on the ISAT and SAT (depending on grade level); (f) express positive change in the areas of self-esteem, peer relationships, and social and emotional development.

Outcomes

Research indicates that the goals and objectives of IMSA PROMISE are being met and the results are encouraging and impressive. The majority of the Black and Latino students currently enrolled at IMSA have participated in one or more of the PROMISE programs. IMSA student retention is 100% for those completing the five program PROMISE pipeline; and IMSA has retained approximately 90% of students who completed at least one PROMISE program.

In addition, many IMSA alumni who participated in the PROMISE programs and the pipeline were STEM majors in college and/or entered STEM career fields. IMSA attributes much of this retention to the PEEP program and the PROMISE alumni who are current IMSA students and who provided leadership for the PROMISE programs. Below is IMSA PROMISE participation data for the previous five years:

Project School Visit	# of Students	# of Schools
School year 2012/2013	755	15
School year 2011/2012	900	23
School year 2010/2011	630	21
School year 2009/2010	270	9
School year 2008/2009	360	12

LS2S	# of Students	# of Schools	# Enrolled in SEAMS	# Enrolled in EIP	# Accepted to IMSA	# Retained/ Graduated from IMSA
2013/2014	98	60	available summer 2014	available summer 2014	available summer 2014	available after fall 2014
2012/2013	104	39	16	7		
2011/2012	40	10	12	3	3	3
2010/2011	49	10	18	5	5	5
2009/2010	32	5	N/A	N/A	N/A	N/A

SEAMS	# of Participants	# Enrolled in EIP	# Applied to IMSA	# Accepted to IMSA	# Retained/ Graduated from IMSA
Summer 2013	69	13	available summer 2014	available summer 2014	available after fall 2014
Summer 2012	70	36	36	26	25
Summer 2011	64	34	41	25	23
Summer 2010	76	21	34	14	12
Summer 2009	60	22	29	17	14
Summer 2008	44	11	25	8	6

EIP	# of Participants	# Applied to IMSA	# Accepted to IMSA	# Retained/ Graduated from IMSA
2013/2014	27	available summer 2014	available summer 2014	available after Fall 2014
2012/2013	50	29	22	21
2011/2012	51	37	24	22
2010/2011	42	30	11	11
2009/2010	38	20	13	10

2008/2009	36	17	10	10
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Combined Programs	# applied to IMSA	# accepted to IMSA
SEAMS/EIP 2012/2013	29	19
LS2S/SEAMS/EIP 2012/2013	5	3
SEAMS/EIP 2011/2012	32	22
LS2S/SEAMS/EIP 2011/2012	5	5

Feedback

Alumni. During a recent interview with IMSA staff, Rhodes Scholar and IMSA graduate ‘07, Rhiana Gunn-Wright thanked the Academy for helping her to hone her academic talents and gifts, and use them for the benefit of mankind. Born and raised on the South Side of Chicago in Englewood, Illinois, Rhiana participated in IMSA PROMISE before matriculating at IMSA.

"IMSA was an incredibly formative experience for me," said Gunn-Wright. She added, *"IMSA taught me to question, to analyze, and, most importantly, to work to change the things in the world that I thought were unjust."*

Parents. Parents also commend the IMSA PROMISE programs for enhancing the educational endeavors of their students as demonstrated in the following statement by Mario and Gloria Ortiz, parents of 2 PROMISE and current IMSA students: *"We wanted to thank you for allowing our sons' participation in PROMISE and commend you on the validity of the programs. Along with EIP, our sons have also experienced Leading Students 2 Success (LS2S) and Summer Enrichment for Academics in Mathematics and Science (SEAMS). These programs have undeniably fostered our sons' interest in STEM and encouraged them to be successful by*

enhancing their knowledge of mathematics, science and English. Hence, creating a strong sense of unwavering academic confidence... We are grateful to you and IMSA for providing our sons with the avenue, PROMISE, to what seems to be a magical institution and beyond.”

Educators. IMSA PROMISE faculty member, Ed Caster, says the following: *“Teaching in the PROMISE programs provides me with the opportunity to work with students who have a passion for learning. The integration of subject matter, technology, and inquiry provides academic opportunities that are often not found in schools. With IMSA students as academic leaders and mentors, the participants learn about life at IMSA and get tips for success in school. IMSA PROMISE provides students with the opportunity to live up to their academic promise.”*

Designing a PROMISE Pipeline: What We Suggest

Although unique to the Illinois Mathematics and Science Academy, PROMISE is a prototype of an adaptable educational program model. After nearly two decades of working with diverse Illinois student populations, we have learned much and offer the following design features for developing similar successful programs that ignite and nurture the educational needs of underrepresented and underserved students:

- Begin the pipeline at 5th grade or earlier and encourage progression through the pipeline;
- Provide Saturday and summer enrichment activities that include educational and social field trips. If feasible, include an afterschool component;
- Work with community organizations, churches, schools, teachers, counselors and school administrators to identify and recruit potential participants;
- Recruit culturally competent faculty/staff (some of whom share a common background with the participants) to develop and implement the curriculum;
- Encourage PROMISE alumni to stay connected with the program as mentors or tutors;
- Utilize an inquiry/problem-based teaching and learning approach;
- Include a mentorship component so that the participants stay connected to the pipeline;
- Hold retreats in which parents, teachers and students are participants;

- Provide internship and research opportunities for older students;
- Seek diverse funding sources.

The internationally recognized Illinois Mathematics and Science Academy[®] (IMSA) develops creative, ethical leaders in science, technology, engineering and mathematics. As a teaching and learning laboratory created by the State of Illinois, IMSA enrolls academically talented Illinois students (grades 10-12) in its advanced, residential college preparatory program, and it serves thousands of educators and students in Illinois and beyond through innovative instructional programs that foster imagination and inquiry. IMSA also advances education through research, groundbreaking ventures and strategic partnerships. www.imsa.edu

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Adrienne Coleman is Multicultural Education Specialist at the Illinois Mathematics and Science Academy. She holds a Master of Science Degree in Health, Physical Education, and Recreation and a Master of Science in Educational Administration and Foundation with an emphasis in College Student Personnel Administration from Illinois State University. Ms. Coleman is a candidate for a doctoral degree in Educational Leadership from Argosy University and her dissertation explores the factors that motivate gifted and talented Black males to engage in science, technology, engineering, and mathematics. acoleman@imsa.edu

Barbara J. Miller is Director of Enrollment and Academic Opportunities at the Illinois Mathematics and Science Academy. She holds a Master of Science in Education with an emphasis on Counseling in Higher Education from Illinois State University and is currently a doctoral candidate in Adult and Higher Education at Northern Illinois University. Ms. Miller is a member of the Board of Directors of the Illinois Association of Gifted Children and serves on the Diverse Gifted Populations Committee. bmiller@imsa.edu