IS STEM FOR ALL?
PERSPECTIVES OF BLACK AND LATINO STUDENTS ON STEM MOTIVATION

Adrienne Coleman, Ed. D.
The Illinois Mathematics and Science Academy
Multicultural Education Specialist
acoleman@imsa.edu

http://works.bepress.com/adrienne_coleman
Introduction
| ISSUE                                                                 | WHY???
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Latino and Black students are academically four years behind their White counterparts and score below approximately 75% of White America in mathematics.</td>
<td>Lack of STEM exposure in K-12</td>
</tr>
<tr>
<td>Fewer than 10% of Latino and Black students complete the high school mathematics sequence, which includes algebra, geometry, trigonometry, and pre-calculus (McGee &amp; Martin, 2011a).</td>
<td>Lack of a STEM mentor</td>
</tr>
<tr>
<td>Latino and Black Students score lower than national averages on math and science achievement tests (ISBE, 2014).</td>
<td>Mathematics phobia</td>
</tr>
<tr>
<td></td>
<td>Failure of students to see the application of science to their lives</td>
</tr>
<tr>
<td></td>
<td>Poor Counseling</td>
</tr>
<tr>
<td></td>
<td>Diminished perception of self</td>
</tr>
<tr>
<td></td>
<td>Funding inequities in K-12 system</td>
</tr>
<tr>
<td></td>
<td>Inexperienced Teachers</td>
</tr>
<tr>
<td></td>
<td>(Crisp &amp; Nora, 2012; Dumais, 2008; QEMN, 2010; Toldson &amp; Brown, 2009).</td>
</tr>
</tbody>
</table>
According to the Washington-based Center for Political and Economic think tank, the U.S. workforce could employ as many as 140,000 additional Black and Latino college graduates in STEM fields annually if the gap in college completion by Blacks and Latinos closed to roughly match that of the White and Asian student graduation rates (Miller & Horrigan, 2014).

The U.S. Congress Joint Economic Commission stated between 2010 and 2020 the overall employment in STEM occupations will increase by 17%, yet not enough students are pursuing degrees and careers in the STEM fields to meet the increasing demand (Casey, 2012).
STEM Significance

- According to the U.S. Census Bureau, the median income for Blacks is $32,229 and $38,624 for Latinos, almost $20,000 less than Whites; but for Latinos and Blacks in STEM careers, the median income is $75,000 which is only about $10,000 less than Whites (Landivar, 2013).

- According to the Georgetown University Center on Education and the Workforce, 63% of those with only associate’s degrees in STEM earn more than those with bachelor’s degrees in non-STEM occupations. In addition, 47% of those with bachelor’s degrees in STEM occupations earn more than Ph.D.s in non-STEM occupations (Crotty, 2011).
The mission of IMSA, the world’s leading teaching and learning laboratory for imagination and inquiry, is to ignite and nurture creative, ethical, scientific minds that advance the human condition, through a system distinguished by profound questions, collaborative relationships, personalized experiential learning, global networking, generative use of technology and pioneering outreach (IMSA, 2015).
Latino and Black STEM Motivation
Findings: STEM Support

All Student Participants
($n_t = 45$, $n_s = 45$, $n_r = 86$)

- Parents: 25 (29%)
- Family: 8 (9%)
- Teacher: 10 (12%)
- Friends: 17 (20%)
- School System: 21 (24%)
- Self: 3 (4%)
- Mentors: 2 (2%)

$n_t =$ Total # of Participants, $n_s =$ Total # of Subjects who responded, $n_r =$ Total # of Responses

Since subjects can respond more than once to the question, the values for $n_t$, $n_s$ and $n_r$ are often not equal.
Why is there a Latino and Black STEM Gap? n = 38

All Student Participants

\( n_t = 45, n_s = 38, n_r = 154 \)

- Lack of STEM vision: 22 (31%)
- Lack of STEM parent support: 9 (13%)
- Lack of quality STEM education: 11 (15%)
- Negative stigma/misperceptions of Black and Latino Students: 17 (24%)
- Lives in Negative Environment: 5 (7%)
- Lack of STEM exposure*: 4 (6%)
- Language Barrier: 2 (3%)
- There is no Gap: 1 (1%)

\( n_t = \text{Total # of Participants}, n_s = \text{Total # of Subjects who responded}, n_r = \text{Total # of Responses} \)

Since subjects can respond more than once to the question, the values for \( n_t, n_s, \) and \( n_r \) are often not equal.

*Includes “Unaware of Future STEM Benefits”
Why are you Engaged in STEM? n = 35

All Student Participants  

t = 45, n = 35, r = 47

- Enjoy STEM: 11 (23%)
- Solve Problems/To Advance Humanity: 11 (23%)
- STEM is a Prominent, Progressive Field: 10 (21%)
- Future Success: 6 (13%)
- Good at STEM: 4 (9%)
- Influenced by Parents: 4 (9%)
- In Pursuit of Scientific Knowledge: 1 (2%)

nt = Total # of Participants, ns = Total # of Subjects who responded, nr = Total # of Responses

Since subjects can respond more than once to the question, the values for nt, ns, and nr are often not equal.
Describe your motivation to pursue/engage in STEM education…\(n = 42\)

All Student Participants (\(n_t = 45, n_s = 42, n_r = 139\))

- **Obligation to Black/Latino Community/Break Negative Stigma**
  - 12 (9%)
- **Solve Problems/ To Advance Humanity**
  - 7 (5%)
- **Learning: Discovery of Knowledge**
  - 10 (7%)
- **Family/ Teacher Influence**
  - 26 (19%)
- **STEM Passion/Enjoyment**
  - 14 (9%)
- **Challenge/ Competitive Nature of STEM**
  - 13 (9%)
- **Future Success**
  - 20 (14%)
- **STEM is a Prominent, Progressive Field**
  - 25 (18%)
- **Money**
  - 7 (5%)

\(n_t = \text{Total # of Participants}, n_s = \text{Total # of Subjects who responded}, n_r = \text{Total # of Responses}\)

Since subjects can respond more than once to the question, the values for \(n_t\), \(n_s\), and \(n_r\) are often not equal.

^ includes being a STEM role model/like STEM role model and being open to new things

^^ includes help suffering people

* includes contentment and good at STEM

** includes instilled values
IMSA’s Contribution to STEM Motivation, n = 37

All Student Participants (n_t = 45, n_s = 37, n_r = 60)
95% say IMSA Enhanced Motivation, n = 35
8% says IMSA Hindered Motivation, n = 3*
*Found Passions in other areas and realization of not being good in STEM!

- Challenge/Better Education
- Immersion in STEM
- Culturally & Intellectually Diverse Environment
- Self-Realization/Independence
- STEM Opportunities
- Balances Uneven Playing Field for Minorities

n_t = Total # of Participants, n_s = Total # of Subjects who responded, n_r = Total # of Responses

Since subjects can respond more than once to the question, the values for n_t, n_s, and n_r are often not equal.
How to Minimize the STEM Gap? \( n = 26 \)

All Student Participants \( (n_t = 45, n_s = 26, n_r = 32) \)

- 13 (41%) Early STEM Exposure*
- 9 (28%) Black and Latino STEM Mentors/Role Models
- 7 (22%) Government/Community Minority STEM Intervention
- 3 (9%) STEM Education for Parents

\( n_t = \text{Total \# of Participants}, \ n_s = \text{Total \# of Subjects who responded}, \ n_r = \text{Total \# of Responses} \)

Since subjects can respond more than once to the question, the values for \( n_t, n_s \) and \( n_r \) are often not equal.

*Includes “Educate on future STEM benefits,” “STEM curriculum needs to be more realistic,” and “STEM Encouragement”
## ACT Scores By Race – 2015

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>IMSA Student</th>
<th>State of Illinois</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>32.2</td>
<td>20.7</td>
<td>21.0</td>
</tr>
<tr>
<td>Asian</td>
<td>33.0</td>
<td>24.3</td>
<td>23.9</td>
</tr>
<tr>
<td>Black/African American</td>
<td>29.6</td>
<td>17.2</td>
<td>17.1</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>30.2</td>
<td>18.6</td>
<td>18.9</td>
</tr>
<tr>
<td>White</td>
<td>32.3</td>
<td>22.5</td>
<td>22.4</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>31.1</td>
<td>21.3</td>
<td>21.2</td>
</tr>
</tbody>
</table>
# IMSA Latino and Black Students College/University Enrollment – 5 years

<table>
<thead>
<tr>
<th>College</th>
<th># of Students</th>
<th>College</th>
<th># of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Illinois at Urbana-Champaign</td>
<td>30</td>
<td>Wellesley College</td>
<td>2</td>
</tr>
<tr>
<td>University of Illinois at Chicago</td>
<td>8</td>
<td>University of Chicago</td>
<td>2</td>
</tr>
<tr>
<td>University of Missouri Columbia</td>
<td>6</td>
<td>Stanford University</td>
<td>2</td>
</tr>
<tr>
<td>Illinois Institute of Technology</td>
<td>6</td>
<td>St. John's University - Queens Campus</td>
<td>2</td>
</tr>
<tr>
<td>University of Pittsburgh</td>
<td>5</td>
<td>Princeton University</td>
<td>2</td>
</tr>
<tr>
<td>University of Pittsburgh</td>
<td>5</td>
<td>Northwestern University</td>
<td>2</td>
</tr>
<tr>
<td>Washington University in St. Louis</td>
<td>4</td>
<td>North Central College</td>
<td>2</td>
</tr>
<tr>
<td>Loyola University</td>
<td>4</td>
<td>Howard University</td>
<td>2</td>
</tr>
<tr>
<td>Saint Louis University</td>
<td>4</td>
<td>Rensselaer Polytechnic Institute</td>
<td>2</td>
</tr>
<tr>
<td>Purdue University</td>
<td>3</td>
<td>University of Southern California</td>
<td>2</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>3</td>
<td>Lake Forest College</td>
<td>2</td>
</tr>
<tr>
<td>Vanderbilt University</td>
<td>3</td>
<td>Massachusetts Institute of Technology</td>
<td>2</td>
</tr>
<tr>
<td>University of Southern California</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROMISE
Providing Opportunities for Mathematics and Science Enrichment

- PROMISE (Providing Opportunities for Mathematics and Science Enrichment) serves underrepresented and economically disadvantaged students who have talent and interest in mathematics and science. The PROMISE pre-admissions programs provide enriching academic experiences that create academic growth and simulate, to some extent, the experience of an enrolled IMSA student.

- Project School Visit (PSV)
- Leading Students to Success (LS2S)
- Summer Enrichment for Academics in Math and Science (SEAMS)
- Early Involvement Program (EIP)
- PROMISE and EXCEL Extension Program (PEEP)
PROMISE Outcomes

- Academic enrichment in STEM fields
- Improvement of eligibility for academy acceptance
- Improved understanding/appreciation of science and mathematics
- Enhance the self-confidence of students... leading to greater success in academics and the total IMSA experience.
- Increase in numbers of underrepresented students in pursuit of degrees and careers in STEM fields
# IMSA and PROMISE Retention

**IMSA Rate of return, by race, c12-c15**

<table>
<thead>
<tr>
<th>Race</th>
<th>All IMSA Students</th>
<th>PROMISE Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depart</td>
<td>Return</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>13</td>
<td>70</td>
</tr>
<tr>
<td>Native American or Alaska Native</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>11</td>
<td>362</td>
</tr>
<tr>
<td>Black or African American</td>
<td>9</td>
<td>63</td>
</tr>
<tr>
<td>White</td>
<td>31</td>
<td>301</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Not Reported</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

- **Depart** refers to the number of students who left the program.
- **Return** refers to the number of students who returned to the program.
- **Rate of return** is calculated as (Return / Depart) * 100%.
PROMISE STEM Pipeline

- LS2S
- STEM Interest & Exposure
- SEAMS
- EIP
- IMSA Student (PEEPS)
- STEM Major in College
- STEM Career
Student Inquiry and Research

The Student Inquiry and Research (SIR) Program serves as a model learning environment that provides a framework for students to conduct original investigations on compelling questions of interest, collaborate with other students and on-campus or off-campus professionals such as educators, researchers and scholars, and to share their investigation results through public presentation and publication.
IMSA Unique Opportunities

• SIR - Student Inquiry and Research
• LEAD (Leadership, Education and Development)
• Considerations in Ethics
• Sophomore Navigation
• Intersession
• TALENT
  • Total Applied Learning for Entrepreneurs
How would you utilize this information to encourage more Latino and Black Students to engage in STEM?
Implications

Early STEM Exposure

- The earlier Black and Latino students are exposed to STEM learning experiences and are consistent throughout their academic careers they will develop the necessary skills and eventually nurture their passion for STEM. In doing so, they will instill a future vision for themselves that involves STEM.
Implications

IMSA as a Model

There are components about IMSA’s approach to teaching and learning that are essential to STEM motivation for Black and Latino students. For one, the participants should not only be culturally but also intellectually diverse, allowing the students to learn from each other due to a variety of perspectives while in a collaborative group. The curriculum should immerse the students in STEM, introducing them to all areas of STEM. In addition, the teaching and learning should be exploratory in nature in order to mold the students into inquiry-based thinkers. The activities should include realistic problem-solving elements that promote participant collaboration and support. The students should work with Black and Latino mentors engaged in STEM that help and encourage the students to solve problems and advance humanity, further enhancing the STEM vision.
Implications

Historical and Current News/Issues Discussion

- In addition to using the STEM immersion technique during these learning experiences, the curriculum should also include historical and current Black and Latino news and issues. This allows Black and Latino students to understand societal perspectives which would **nurture their obligation to their community and the world**. The state of awareness of themselves and those around them will grow which could entice their want to develop as students. Recognizing this, could increase their ability to understand themselves: who they are as a student, how they think and learn, and then discovering what is important to them. This process not only builds self-confidence but promotes resilience.
Implications

Personalized Assessment and Evaluation

- Black and Latino Students should be regularly assessed to understand their strengths and weaknesses; then personalized evaluations should be created to emphasize their strengths and inform the development of improving their weaknesses. This demonstrates to them the importance of collaboration by showing how a diversity of strengths and weaknesses can assist in solving problems. In terms of competition, showing some success in certain areas will ultimately help build self-confidence and enhance the students’ awareness of areas that need improvement. This enhances the will to do better amongst the Black and Latino students. Furthermore, it establishes a support system for the student with the teacher because the teacher will personally know what each specific student needs to progress.
Implications

Leadership Opportunities

- The STEM areas in which the Black and Latino Students have demonstrated strength need to be complemented with an activity in which the student can lead that has a problem-solving component to it. Then the student should be provided with leadership opportunities, outside of STEM, and encouraged to be versatile. This will allow them to develop leadership skills needed to be successful STEM leaders in a global world.
Question and Answer
References


