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Diversifying the STEM Education to Career Pipeline

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DIVERSIFYING THE STEM EDUCATION TO CAREER PIPELINE!!!

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STEM (science, technology, engineering and mathematics)

- "an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy (National Center on Gifted and Talented, 2013)."
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.

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.
“We don’t want to just increase the number of American students in STEM. We want to make sure everybody is involved... That means reaching out to boys and girls, men and women of all races and all backgrounds. Science is for all of us. And we want our classrooms and labs and workplaces and media to reflect that.”

- Former President Barack Obama
While 32 percent of White students and 47 percent of Asian students scored at proficient or above in MATH, only 7 percent of Black students and 12 percent of Hispanic students did (NAEP, 2013).

While the average score in Science was 163 for White students and 159 for Asian students, it was 129 for Black Students and 137 for Hispanic Students (NAEP, 2011).
STEM Education

Fewer than 10% of Black and Latino students complete the high school mathematics sequence, which includes algebra, geometry, trigonometry, and pre-calculus.

Latino and Black students are academically four years behind their White counterparts and score below approximately 75% of White America in mathematics.

Percentage of Bachelor’s Degree Recipients Majoring in STEM Subjects

Source: Author’s calculations from Integrated Postsecondary Education Data System (IPEDS) data for July 1, 2012 – June 30, 2013. The majors included are those with a two-digit Classification of Instructional Programs (CIP) code in the following categories: computer and information sciences and support services, engineering, biological and biomedical sciences, mathematics and statistics, and physical sciences.

The Racially-Based STEM Education and Career Gap

- The 2015 U.S. News/Raytheon STEM Index indicates a slow progression in addressing these inequities that are a result of “early bias, discrimination and social expectations”.
  - Lack of STEM exposure in K-12
  - Lack of a STEM mentor
  - Mathematics phobia
  - Failure of students to see the application of science to their lives
  - Funding inequities in K-12 system
## Diversifying STEM Think Tank

\[ n_t = 84, n_r = 96 \]

### Vision Gap
Lack of STEM vision - No Role Models/Mentors, STEM is too White (I’m the only one who looks like me in STEM) - Racial Isolation in STEM programs/classes, Being in STEM is not cool, No external motivation - lack sense of belonging

### Opportunity Gap
Lack of STEM Exposure / Access

### Cultural/Perception Gap
Stereotype Threat - Negative stigma/misperceptions of Black and Latinx Students - STEM is too challenging - Want to hide intelligence - Systematic Bias

### STEM Education Gap
Lack of quality STEM education/teacher preparedness and interest - Lack of practical application in STEM teaching and learning

### Generational Gap
Parents lack STEM knowledge/significance/how to advocate/linguistic barriers

### Economic Gap
Schools System Funding Issues/Funding for Families

### Identification Gap
Lack of STEM talent identification by teachers and/or parents - No training for teachers

### STEM Professional to Educator Gap
Discouragement of STEM Professionals to become STEM Educators - State of Illinois has made it challenging for STEM Professionals to become teachers due to certification rules
## Diversifying STEM Think Tank

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<td><strong>Generational Gap</strong></td>
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<td>Examine Teacher Certification Processes and develop an expedited process for those STEM Professional who want to go in to the classroom</td>
</tr>
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</table>
Bias in STEM Research

- Dissertation: An Exploration of the Factors that Motivate Gifted and Talented Black Males to Engage in STEM.
- Articles
The Illinois Mathematics and Science Academy

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).
CULTURALLY AND LINGUISTICALLY DIVERSE GIFTED/TALENTED STUDENTS STEM MOTIVATION
Findings: STEM Support

All Student Participants
($n_t = 85, n_s = 85, n_r = 86$)

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

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

Since subjects can respond more than once to the question, the values for $n_t$, $n_s$, and $n_r$ are often not equal.
Why is there a Latino and Black STEM Gap? n = 68

All Students - (nt = 85, ns=68, nr=126)

- Lack of STEM vision
- Lack of STEM parent support
- Negative stigma/misperceptions of Black and Latino Students
- Lack of quality STEM education
- Lack of STEM exposure*
- Lives in Negative Environment
- Language Barrier
- STEM is too challenging

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.

*Includes “Unaware of Future STEM Benefits”
Why is there a Latino and Black STEM Gap? $n = 143$

Students, Parents, Faculty/Staff
($n_t = 163, n_s = 143, n_r = 230$)

- Lack of STEM vision: 3 out of 143 (2.1%)
- Lack of STEM parent support: 1 out of 143 (0.7%)
- Lack of quality STEM education: 6 out of 143 (4.2%)
- Negative stigma/misperceptions of Black and Latino Students: 9 out of 143 (6.3%)
- Lack of STEM exposure: 17 out of 143 (12.0%)
- Lives in Negative Environment: 48 out of 143 (33.6%)
- STEM is too challenging: 40 out of 143 (28.0%)
- Language Barrier: 26 out of 143 (18.2%)
- There is no Gap: 80 out of 143 (55.7%)

$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.
Culturally and Linguistically Diverse Students
Motivation to Engage in STEM, n = 78

All Student Participants
(n_t = 85, n_s = 78, n_r = 276)

- Obligation to Black/Latino Community/Break Negative Stigma
- Solve Problems/ To Advance Humanity
- Learning: Discovery of Knowledge
- Future Success/STEM is a Prominent, Progressive Field
- STEM Passion/Enjoyment
- Family/ Teacher Influence
- Money
- Challenge/ Competitive Nature of STEM

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.
^ 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
Culturally and Linguistically Diverse Students
Motivation to Engage in STEM, n = 152

Students, Parents, Faculty/Staff
(n_t = 163, n_s = 152, n_r = 449)

- 85 (19%)
- 73 (16%)
- 67 (15%)
- 63 (14%)
- 49 (11%)
- 44 (10%)
- 32 (7%)
- 23 (5%)
- 11 (2%)

- Obligation to Black/Latino Community/Break Negative Stigma
- STEM Passion/Enjoyment
- Future Success/STEM is a Prominent, Progressive Field
- Learning: Discovery of Knowledge
- Solve Problems/To Advance Humanity
- Family/Teacher Influence
- Challenge/Competitive Nature of STEM
- Money
- Self-Motivated
- Leadership

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.
^ 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

\[ n = 69 \]

All Student Participants
\( (n_t = 85, n_s = 69, n_r = 126) \)

- **Challenge/Better Education**: 29 (23%) responses
- **Immersion in STEM**: 1 (1%) response
- **Culturally & Intellectually Diverse Environment**: 24 (19%) responses
- **Self-Realization/Independence**: 25 (20%) responses
- **STEM Opportunities**: 13 (10%) responses
- **Loss of Motivation**: 1 (1%) response
- **Balances Uneven Playing Field for Minorities**: 11 (9%) responses
- **Collaborative Support Group**: 22 (17%) responses

\( n_t = \) 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.
IMSA’s Contribution to STEM Motivation

\[ n = 144 \]

Students, Parents, Faculty/Staff
\[ (n_t = 163, n_s = 144, n_r = 289) \]

- Challenge/Better Education: 60 (21%)
- Culturally & Intellectually Diverse Environment: 34 (12%)
- Immersion in STEM: 62 (21%)
- Collaborative Support Group: 34 (12%)
- Self-Realization/Independence: 41 (14%)
- STEM Opportunities: 23 (8%)
- Loss of Motivation: 1 (0%)
- Balances Uneven Playing Field for Minorities

\[ n_t = \text{Total # of Participants}, \quad n_s = \text{Total # of Subjects who responded}, \quad n_r = \text{Total # of Responses} \]

Since subjects can respond more than once to the question, the values for \( n_t \), \( n_s \), and \( n_r \) are often not equal.
How to Minimize the STEM Gap? \( n = 37 \)

All Student Participants
\( n_t = 85, n_s = 37, n_r = 45 \)

- Early STEM Exposure: 18 (40%)
- Black and Latino STEM Mentors/Role Models: 12 (27%)
- Government/Community Minority STEM Intervention: 7 (16%)
- STEM Education for Parents: 6 (13%)
- Confront Stereotype Threat: 2 (4%)

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

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?  \( n = 101 \)

Students, Faculty, Staff  
(\( n_t = 163, n_s = 101, n_r = 118 \))

- Early STEM Exposure: 55 (47%)
- Black and Latino STEM Mentors/Role Models: 41 (35%)
- Government/Community Minority STEM Intervention: 10 (8%)
- STEM Education for Parents: 8 (7%)
- Confront Stereotype Threat: 4 (3%)

\( n_t \) = 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.
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 educator/STEM Professional 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.
Adrienne L. Coleman, Ed.D.

- M.S. in Health Education
- M.S. in Educational Administration
- Ed.D. in Educational Leadership

- Illinois State University
- AmeriCorps Member
- Rutgers University
- USA Delegation Team to Moldova
- IMSA - SIR
- IMSA PROMISE
- NAACP
- James R. Jordan Foundation
- Fermilab
- American Statistics Association

Interests
- Golfer, Music Enthusiast (House-Head), Traveler, Social Justice Activist

Adrienne, beyond definition or conscious comprehension; knowledgeable, professional, Spiritual, honest, seeking, Black, creative, changing, on a continuous mind-trip, thoughtful, loving, complex - yet simple, unique, cultural, being!
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)
The TARGET Program is a highly competitive, paid, six-week summer internship opportunity for Illinois high school sophomores and juniors who have strong interest and demonstrated aptitude for physics, mathematics, computer science and engineering. The program’s goals are to encourage high school students to undertake college study and pursue careers in STEM disciplines.

TARGET encourages and aims to increase the representation of underrepresented minorities (Black, Hispanic/Latino, Hawaiian/Pacific Islander, Alaska Native /American Indian) and women in the sciences and engineering at the college level and consequently the workforce.
The Google in Residence (GIR) program was created to support greater diversity in the tech industry. In partnership with computer science departments at Historically Black Colleges and Universities (HBCUs), Googlers—experienced software engineers—spend four to five months on campuses, teaching introductory computer science classes.

Google's Computer Science Summer Institute (CSSI) is a three-week introduction to computer science for graduating high school seniors with a passion for technology—especially students from historically underrepresented groups in the field.
Statistics is an opportunity to try something different. However, it can be challenging, but with real-life application it can lead to future success.
The curriculum should immerse students in statistics in which they work with real data, addressing real world problem and be inclusive:

- Teachers who are knowledgeable of statistics, fun, relatable and can demonstrate how statistics informs decision-making,
- **Integration of real-world problem solving in the curriculum** related to business, sports, politics and other topics personalized to students’ interest,
- Presenters who share their experiences as statisticians, including the **economics of entering a statistics career** and how statistics can assist in examining societal problems,
- Projects that allow students to **view & analyze news programs, sports analysis shows, web-site (i.e.Google/YouTube) analytics, or Reality TV shows** such as Shark Tank should be incorporated to demonstrate and reflect on how statistics is immersed in society,
- Discussions on college majors that utilize statistics and **the importance of having a base knowledge prior to pursuing higher education**, 
- **Incentives** such as food, music, trips, conferences, networking opportunities, and stipends.
- Workshops on informed decision-making and empowerment to **develop self-confidence**, 
- **Trips** that are both educational and cultural in nature to expand knowledge of statistics and self, as well as experience the global world,
- Integration of statistics related to social injustices, impacting marginalized groups.
References


