Diversifying the STEM Education to Career Pathway!!!

The Illinois Mathematics and Science Academy

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**Race/Ethnicity**

Black/African American

**Sex**

Female

**Gender**

Cisgender

**Sexual Orientation**

Heterosexual

**Values/Beliefs**

Equity, Fairness and Inclusiveness

**Pronouns**

She, Her, Hers

**What’s a name I was called that I did not like?**

Spooky, Angry Black Woman, Blackie

**Do I have Bias?**

Yes

**What social justices have I had to confront?**

Racism, Colorism & Sexism
Race/Ethnicity

Sex

Gender

Sexual Orientation

Values/Beliefs

What’s a name I was called at some point in your life that I did not like?

Pronouns

Do I have Bias?

What social justices have I had to confront?

INSERT NAME HERE: ____________________________________________________________________

SELFIE
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.
While 44% of White students and 62% of Asian students scored at proficient or above in MATH, only 13% of Black students and 20% of Hispanic students did – 8th grade (NAEP, 2017).

While the average score in Science was 166 for White students and 164 for Asian students, it was 132 for Black Students and 140 for Hispanic Students (NAEP, 2015).
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.

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 National Academy of Sciences suggests that, without the participation of individuals of all races and genders, the increasing demand for workers in STEM fields will not be met, potentially compromising the position of the United States as a global leader” (2014).

“The additional benefit of developing a STEM-literate and well-trained domestic workforce is that this ensures that we adequately address challenges related to healthcare improvement, national production capacity, and research excellence” (Allen-Ramdial & Campbell, 2014).

Implicit Bias in STEM

- Our modern understanding of science and knowledge originates from the European Enlightenment.
- Nonwhites and women have historically been viewed as emotional, irrational, childlike, and not possessing scientific capabilities.
- Beyond the structures that hinder minority gains in the sciences, interpersonal biases continue to be a factor for those who work in the STEM fields.
- Research continues to demonstrate how academic and workplace settings are often spaces in which feminine and ethnic identities are not valued or recognized.
- The historical and institutional meaning of what it means to be a scientist (a white male identity) continues to underprivileged diverse populations.
Equity:

• When some are excluded or lack the knowledge, income, equipment, or [resources] necessary to participate fully in public discourse, they must overcome obstacles to access in order to ensure fairness. In other words, fairness also demands remedies to redress historic injustices that have prevented or diminished access in the first place …. in order to maximize opportunities for access experienced by certain groups, a good society commits resources in order to level the playing field.

• Equity-Mindedness:

  • The outlook, perspective or mode of thinking exhibited by those who call attention to patterns of inequity and are willing to assume personal/institutional responsibility for the elimination of inequity. This includes being “conscious,” noticing differences in experiences among cultural groups, and being willing to talk about race, gender, class, sexual orientation, ability, ethnicity as an aspect of equity. Equity perspectives are evident in actions, language, problem-solving, & cultural practices.
In this first image, it is assumed that everyone benefits from the same support. They are being treated **equally**.

Individuals are given different support to make it possible for them to have equal access to the view. They are being treated **equitably**.

All three can see the view without any support because the cause of inequality was addressed. The systemic barrier has been **removed**.
**Methodology**

**Diversifying STEM to Education Pathway, N = 415**

Through qualitative research methodologies, students engaged in STEM, their parents, STEM educators, STEM professionals, and Community Organizations that implement STEM programming were asked to provide their perspectives and share their stories related to the intersection between race and STEM.

- **The Motivation of Black and Latino Students to Engage in STEM, n = 281**
  - 106 high school students, 86 middle school students, 27 STEM educators, 51 parents & 11 college students.

- **Diversifying STEM Think Tank, n = 134 from 64 organizations**
  - To understand from the perspectives of STEM professionals, Educators, and Diversity/Inclusion Officers strategies to diversify and strengthen the STEM education to career pipeline.

**Critical Race Theory**

Attempts to understand American education and reform, acknowledging the unique perspective and voice of people of color as victims of oppression in racial matters and valuing their story telling as a legitimate way to convey knowledge (Khalifa, Dunbar, & Douglas, 2013).
Factors that Motivate Black and Latino Students to Engage in STEM Education

\( n_t = 281, \ n_r = 655 \)

- Obligation to Black/Latino Community/Break Negative Stigma - Be different
- Future Success/STEM is a Prominent, Progressive Field
- Learning: Discovery of Knowledge and real-life applicability
- STEM Passion/Enjoyment
- Solve Problems/ To Advance Humanity
- Family/ Teacher Influence
- Challenge/ Competitive Nature of STEM
- Money
- Self-Motivated
- Not good at math
- Leadership

\( n_t = \text{Total # of Participants}, \ n_r = \text{Total # of Responses} \)

Since subjects can respond more than once to the question, the values for \( n_t \) and \( n_r \) are often not equal.
IMSA Black and Latinx Students
Diversifying STEM Education to Career Pathway

D-STEM Equity Model

- Vision Gap
- Opportunity Gap
- Cultural Perception Gap
- STEM Education Gap
- Generational Gap
- Economic Gap
- Identification Gap
- STEM Professional to Educator Gap

The Systemic Problem
Racial Inequity in STEM Education and Careers

STEM Motivation
Factors that generate interest in and motivate Black and Latino students to engage in STEM education, majors and careers

Bridging the Racial STEM Divide
Policy-driven mandates to form stakeholder collaboration and funding

Early STEM Exposure
Culturally Responsive STEM Curriculum
Conversations on Race
Personalized Assessment and Evaluation
STEM Leadership Development

Collaborative STEM Initiative
STEM Education Community Organizations
STEM Industry

Culturally Responsive Pedagogy
Teacher Certification and Professional Learning Curriculum

Racially-based collaborative stakeholder approach to STEM programming (PreK-16) mandated by policy that addresses problems collectively and is driven by STEM motivation factors, with an emphasis on developing culturally-responsive teachers

Increase in motivation of Black and Latino students to engage in STEM education

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Culturally Responsive STEM Curriculum
Diversity Curriculum

A Diversity, Epidemiology and social justice unit was incorporated into the Physiology and Disease curriculum in Fall 2016. Students discussed topics such as social and cultural influences on diversity thinking, and selective treatment in hospitals based on race. It was very noteworthy that students were united in their thinking regarding diversity and inclusion, despite the fact that they were from different backgrounds and diverse cultures.
In 2017, additional discussions were held on equity in education. Students who were otherwise reserved were encouraged enough to express their views, and everyone appreciated the fact that they had been included.
Diversity Curriculum

In 2018, students held discussions on LGBTQ+ and equality in social situations. Students brought up many real life case studies in their discussions and debated on the “right” way to deal with gender identity and sexual orientation. This was a delicate topic in the classroom but students had no hesitation to voice their opinions.
Rationale

Humans are by nature egocentric and socio-centric as well. We believe that the groups we belong to are right, privileged, special. We systematically deceive ourselves into thinking that we are right, we avoid recognizing our biases and treat people and groups without due consideration and respect, even when there is clear evidence to refute our point of view. (Elder, 2004).

Rationale (continued)

- Students at the Illinois Mathematics and Science Academy are selected for their aptitude in Math and Science.
- Perception of inequality and exclusion among gifted population.
- Promote awareness of natural egocentric and socio-centric tendencies.
- Reason unbiasedly through diversity issues.
Goal of this Unit

Through this unit, I hope to teach students to be aware of, and to guard against, their native egocentric and socio centric tendencies. Otherwise these tendencies will keep them from reasoning well through diversity issues.
Introducing Diversity into the Science Classroom

- PAD is a Biology elective for juniors and seniors at IMSA that deals with changes in homeostasis in the human body and its outcomes, as well as pathophysiology of disease formation.
- The diversity unit was integrated into the nervous system unit because this seemed to be the best fit in the curriculum.
Introduction of Diversity Curriculum

- Students were given diversity topics and were provided with an introduction, rationale, recent events and a list of readings for these topics.

- They were required to synthesize the information with recent events and create a short presentation building specific case studies for discussion with their peers.

- Emphasis was placed upon discussions dissecting the ethics and moral dilemmas of recent events in the light of the background provided.
Incorporating Diversity Curriculum

- Two sections of 20 students each were provided with background information and asked to present to each other during the 100 minute class.
- Students brought up many interesting views but were united in their thinking.
- This was very noteworthy considering the fact that they were all from different backgrounds and diverse cultures.
Diversity Discussion Topics
2016

• Some of the topics discussed included:
  ○ Brain preferences in terms of diversity
  ○ Social and cultural influences on Diversity Thinking
  ○ Diversity Development in the Brain
  ○ Early development of diversity thinking
  ○ Social justice and epidemiology and
  ○ Selective Treatment in Hospitals Based on Race
Student Reflections on Diversity Discussions

- Students independently incorporated cases of social injustice against people of color into every single topic discussed.
- Students discussed causes for social injustice such as disparity in income, lack of education, and lack of tolerance toward people of other races.
- An interesting case study discussed was that of identical twins brought up in different environments, one tolerant and the other not tolerant toward people of color, and following their path through adolescence and adulthood.
- Their discussions brought forth many aspects of diversity that enhanced their learning by integrating real life experiences.
History of Diversity in Physiology 2017

- In Fall 2017, students were introduced to additional diversity awareness through the development of the history of physiology and medicine.
- Special emphasis was placed upon social, racial and gender barriers.
- Students presented information from scholarly papers provided to them to set the background.
- They then discussed the situations presented and took sides voicing their opinions.
Student Discussions on History and Inventions

- It greatly benefitted students to be aware of the diversity, or lack thereof, of the times when these inventions and discoveries were made.

- They appreciated better the circumstances of these discoveries and their modernization.

- Students focused on specific events in the history of education and medicine and led short discussions on:
  - the ethics of the decisions made
  - the modern reaction to these events and
  - how knowledge of these events might improve their education and social awareness of justice and equality.
LGBTQ+ Discussions 2018

- Students were encouraged to discuss LGBTQ+ awareness in social situations.
- Students pulled up specific case studies from recent news to discuss in class.
- Students showed no hesitation in discussing these topics and felt safe in voicing their opinions on gender identity and sexual orientation.
LGBTQ+ Activity

• Each person
  • picks a colored paper out of the hat
  • finds others who picked the same color
  • discusses their topic in their small group
  • gets together to discuss as a large group
Next Steps

- The success of this project has set the stage for development of diversity curriculum for other disciplines and other schools in the state of Illinois.
- The ease of inserting this unit into an advanced biology course is encouraging and suggests that incorporation into other disciplines should be a smooth transition.
- Students greatly benefit by relating to and thinking about diversity with respect to their learning.
- Steps are under way to further develop this curriculum and train other educators to do the same in their academic institutions.
CULTURALLY RESPONSIVE PEDAGOGY

Instruction and interaction that allow students to maintain the integrity of their cultural identity, while succeeding academically and socially-emotionally. In culturally responsive pedagogy, faculty use aspects of students’ cultures in an asset-based approach as opposed to deficit-based to make academic and student life relevant to them, and increase their skill acquisition, engagement, and learning outcomes. (National Institute for Learning Outcomes Assessment).
CULTURALLY RESPONSIVE PEDAGOGY

• We have an academic responsibility and a moral obligation to provide students with an inclusive education that will enable them to deal with the contingencies of living in a diverse world.

• Research shows that when students are taught from an inclusive curriculum they are eager to learn; they are more engaged in the teaching/learning process.

• Faculty who are involved in integrating diversity into their curriculum report that their teaching is revitalized, their student evaluations improved, and their overall job satisfaction increased.

• It benefits both minority and majority students, especially in improving attitudes and feelings toward intergroup relations.

• Has a positive impact on students’ attitudes toward racial issues, fostering opportunities for interacting in deeper ways with diverse perspectives and cognitive development.
CULTURALLY RESPONSIVE PEDAGOGY

Course description and objectives that reflect diversity - How does my discipline help prepare students to live and work in today’s global/interdependent world?

Content integration that includes multiculturalism—What issues of diversity, social justice, and civic engagement are infused in my course curriculum & how?

Instructional resources and materials—How inclusive are my selected materials?

Faculty and student worldviews and learning styles—How do student and faculty worldviews, learning styles, and teaching strategies match, and how are my students’ learning styles accommodated?

Instructional strategies—How diversified are my strategies for facilitating instruction and classroom dynamics?

Equity-mindedness - What are some inequities that exist and in what ways do I make my teaching personalized and responsive to these inequities?

Assessment diversification—How do assessment activities accommodate my students’ learning styles?
HOW DO WE GET THERE?
BEGIN WITH CULTURAL COMPETENCE – WHERE ARE YOU ON THE CONTINUUM?

http://webtutorials.ucsd.edu/ccmp/01_02_005.html

**NEGATIVE**

- Cultural Destructiveness: forced assimilation, subjugation, rights and privileges for dominant groups only
- Cultural Incapacity: racism, maintains stereotypes, unfair hiring practices
- Cultural Blindness: differences ignored, treats everyone the same, only responds to needs of dominant group

**POSITIVE**

- Cultural Proficiency: implements change to respond to cultural needs, do research and teach
- Cultural Competence: recognize individual and cultural differences, seeks advice from diverse groups, hires unbiased staff
- Cultural Pre-competence: explores cultural issues, are committed, assess needs of organization and individuals
References


