THE POWER OF TEACHING: STEM EDUCATION FOR A BETTER WORLD

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THE POWER OF TEACHING

- For students’ academic learning
- For students’ sense of belonging
- For students’ sense of themselves as smart, capable, and for their perseverance

BUT—

It works both ways.

Listen to the power of teaching through the voices of students.

Was there a teacher who had a significant impact on you?
VIDEO: WAS THERE A TEACHER WHO HAD A SIGNIFICANT IMPACT ON YOU?
We leave the power of teaching to chance.
Teaching can do great harm.
Teaching can have powerful positive impact.
(HOW) CAN WE DELIBERATELY MAKE STEM TEACHING A FORCE FOR JUSTICE?

➤ How do we harness the power of STEM teaching for individual flourishing, and for a just society?

➤ How do we educate so that we stop wasting lives, stop hate and killing? (Maisha Winn, Ihab Hassan)

➤ How do we use the opportunity of our times?
PRIORITY RECOMMENDATIONS

1. Strengthen the student educational experience
2. Increase completion and reduce inequities
3. Control costs and increase affordability
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1. Strengthen the student educational experience
2. Increase completion and reduce inequities
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AMERICAN ACADEMY OF ARTS AND SCIENCES
COMMISSION ON THE FUTURE OF
UNDERGRADUATE EDUCATION (2017)

PRIORITY
RECOMMENDATIONS

1. Strengthen the student educational experience

2. Increase completion and reduce inequities in costs and increase affordability

This means teaching.
WHAT IS THE “STUDENT EDUCATIONAL EXPERIENCE”? 

Experiences shaped by and with—

- the quality of teaching
- interactions and relationships with faculty and with other students, in and outside of classes
- the significance and relevance of the curriculum
STUDENTS’ EDUCATIONAL EXPERIENCES: CONNECTING THE MACRO AND MICRO

(Cohen, Raudenbush, & Ball, 2003; Ball & Forzani, 2007; Ball, 2018)
A CLOSE LOOK AT THE POWER OF TEACHING
What number does the orange arrow point to?

Explain how you figured it out.
LAKEYA

What number does the orange arrow point to? __________

Explain how you know: Because there are equal parts and you are pointing to the second one so that is 2.

JAMARI

What number does the orange arrow point to? __________

Explain how you know: First I thought it was 5 because the zero messed me up.

MARIANA

What number does the orange arrow point to? __________

Explain how you know: How I know its zero is that there is an interval from zero to one, there was 2 line between 0 and 1.

LARRY

What number does the orange arrow point to? __________

Explain how you know: I count it by 1 and keep going 9 till I got whole.

Write a complete sentence with one goal for yourself for our math class today. Give an example of what it looks like to do this really well.

Learn more about the number line.
What do Aniyah and Toni know and what can each do?
VIDEO: ANIYAH AND TONI

Teacher: Listen closely and see what you think about her reasoning and her answer.

This video and additional supporting materials are available online here.
WHAT DO MANY “HEAR” IN ANIYAH AND TONI?

ANIYAH

- She has the wrong answer: 1/7

TONI

- She is playing with her hair and trying to get attention
- She is trying to embarrass Aniyah
WHAT DO ANIYAH AND TONI KNOW AND WHAT CAN EACH DO?

ANIYAH

- Uses the definition for a fraction to explain
  - She identifies the “whole”
  - She makes sure the intervals are equal
  - She counts intervals and not tick marks
  - She knows how to write “one-seventh”

- Produces a mathematically well-structured explanation

- Presents her ideas clearly

TONI

- Listens closely to a classmate’s presentation

- Uses the definition for a fraction to ask
  - How Aniyah decided on 7 parts

- Asks a pointed mathematical question
IN THIS MOMENT, A MOVE CAN REPRODUCE PATTERNS OF MARGINALIZATION OF BLACK GIRLS

NORMALIZED NEXT MOVES

- Clarify for Aniyah that the whole is the interval from 0 to 1
- Asking the class to indicate agreement/disagreement
- “What do others think?”

RESULTS

- Aniyah’s answer is signaled to be incorrect and she is positioned as not having contributed to the work.
- Aniyah’s solution is “voted” on by her classmates
- Aniyah is excluded and her mathematical point is sidelined.
## IN THIS MOMENT, TOO

### NORMALIZED NEXT MOVES

1. “Toni, when you’re ready to participate appropriately by not playing with your hair and laughing, and have a question to ask, I will come back to you.”

2. “You need to be a better listener, Toni. Aniyah already explained why she picked one-seventh. Who else has a real question for Aniyah?”

3. “What do others think?”

### RESULTS

1. Toni is publicly excluded from the discussion.

2. Toni is judged to not be listening, her question is judged as not good, and she is excluded from the discussion.

3. Toni is excluded and her mathematical point is sidelined.
LOOKING AT THE MICRO THROUGH THE MACRO: BLACK GIRLS’ RATES OF SUSPENSION

Epstein, Blake, & González (2017)
COUNTERING THE PATTERN

Acknowledge publicly the importance of Toni’s question.

RESULT

Toni is trusted, seen, and recognized for her contribution to the mathematical work:

- The mathematical precision of her question
- Asking Aniyah a question instead of disagreeing.
COUNTERING THE PATTERN
Ask students to ask questions of the presenter, forestall agreeing/disagreeing.

RESULT
Maintain Aniyah’s authority and agency and position her and her thinking to advance the key mathematical idea.
ANIYAH
- Identified the “whole” as 0 to 1 on the number line

TONI
- Modeled at the board a complete explanation of how to understand and identify a fraction on the line

THE OTHER CHILDREN
- Developed a depth of understanding of fractions as numbers on the line and how to explain them
- Saw Black girls’ brilliance
WHAT DOES IT TAKE TO DISRUPT THE PATTERNS THROUGH WHICH BLACK GIRLS ARE MARGINALIZED?

- Seeing Aniyah’s solution and Toni’s question as mathematically sophisticated and key to the class’s work
- Taking as axiomatic the brilliance of Black girls, and thus Aniyah and Toni
- . . . And having something different to do

THE QUALITY OF THE EDUCATIONAL EXPERIENCE DEPENDS ON CRITICALLY CONSCIOUS PROFESSIONAL PRACTICE
<table>
<thead>
<tr>
<th>Speaker</th>
<th>Talk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher</strong></td>
<td>Who would like to try to explain what you think the answer is? And show us your reasoning by coming up to the board. Who'd like to come up to the board and try to tell? And you know, it might not be right. That's okay because we're learning something new. I'd like someone to come up and sort of be the teacher and explain how you are thinking about it. Who'd like to try that this morning?</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Okay, Anyone?</td>
</tr>
<tr>
<td><strong>Non-Other children</strong></td>
<td>Playing with hair</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>When someone's presenting at the board, what should you be doing?</td>
</tr>
<tr>
<td><strong>Students in chaos</strong></td>
<td>Looking at them,</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Looking at that person</td>
</tr>
<tr>
<td><strong>Anyone</strong></td>
<td>You want me to write it?</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>You're trying to mark what you think this number is and explain how you figured it out.</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Listen closely and see what you think about her reasoning and her answer. (Anyone writes 1/2 by the orange dot).</td>
</tr>
<tr>
<td><strong>Anyone</strong></td>
<td>I put one-seventh because there's</td>
</tr>
<tr>
<td><strong>Non-</strong></td>
<td>Still she say one-seventh?</td>
</tr>
<tr>
<td><strong>Anyone</strong></td>
<td>Sort of and then... (continues to write) Because there's seven equal parts, one, two, three, four, five, six, and then seven. (Uses her fingers to count the parts on the number line).</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Before you agree or disagree, I want you to ask questions if there's something you don't understand about what she did. No agreeing and disagreeing. Just: All you can do right now is ask Any questions. Who has a question for her?</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Okay, Tori, what's your question for her?</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>You did not</td>
</tr>
<tr>
<td><strong>Non</strong></td>
<td>Why did (PFN another student who says something to her from across the room)</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Go ahead, it's your turn.</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>Why did you pick one-seventh?</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Left listen to her answer now. That was a very good question.</td>
</tr>
</tbody>
</table>

![Diagram](image)
Teacher: Who would like to try to explain what you think the answer is? And show us your reasoning by coming up to the board?

Teacher: Okay, Anya?

Anya: Playing with hair
Laying on arms

Teacher: When someone's presenting at the board, what should you be doing?

Student A: Looking at them.

Teacher: Looking at that person.

Teacher: Um huh?

Anya: You want me to write it?

Teacher: You're trying to mark what you think this number is and explain how you figured it out.

Teacher: Listen closely and see what you think about her reasoning and her answer. (Anya writes) 1/6 by the orange one.

Anya: I put one seventh because there's still six left one is used.

Teacher: Dante? Yeah, (continues to write) because there's seven equal parts, two, one, two, two, two, two, and seven. Give her fingers to count the parts on the number one.

Teacher: Before you agree or disagree, I want you to ask questions if there's something you don't understand about what she did. No agreeing and disagreeing. Just: All you can do right now is ask Anya questions. Who has a question for her?

Teacher: Okay, Tom, what's your question for her?

Dante: You did not!

Teacher: You did not?

Dante: Why did you? (laugh at another student who says something to her from across the room)

Teacher: Go ahead, it's your turn.

Teacher: Why did you pick one-seventh?

Teacher: You did not.

Teacher: Let's listen to her answer now. That was a very good question.
TEACHING IS DENSE WITH "DISCRETIONARY SPACES"
WHAT REGULARLY FILLS THE DISCRETIONARY SPACES IN TEACHING?

- Instructors’ experiences in a society filled with racism and oppression.
- Normalized practices in higher education that institutionalize dominant values and habits.

Lortie (1975), Banks, Grant and Koskela, Moll
Anyon (1981), Heath, Martin, Tuck
WHAT REGULARLY FILLS THE DISCRETIONARY SPACES IN TEACHING?

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Professional education does not effectively intervene on these.

Professional education and teaching experience often teach these.
DEVELOPING THE PROFESSION
THE INTERACTIONS AMONG WHAT, HOW, AND WHO
THE WORK OF JUSTICE LIVES INSIDE THE WORK OF TEACHING

- By understanding one’s identity and role as part of a broader system of oppression that is historical and persistent
- By knowing what “normally” happens and how these patterns reproduce oppression, and by deliberately doing things that counter those patterns
- By seeing and affirming each student—their strengths and their mathematical work
- By opening up “content” and possibilities for students to connect with and do mathematical work

Mann, Willis, Hickman, Ball, Goffney, (2017)

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(HOW) CAN TEACHING WORK FOR JUSTICE?

INVISIBLE WORK
- Purposefully and efficiently reads students’ work while circulating
- Selects a student to present who will push the conceptual understanding forward, and for whom this positioning will be significant
- Disrupts racist and gendered patterns by:
  - Believing that Black girls are smart; knowing Aniyah and Toni and their smartness in this specific lesson
  - Trusting the children to think, be engaged, try to learn
  - Making choices about how to read children and what not to make an issue of

VISIBLE WORK
- Supports Aniyah to present skillfully at the board, using representations; encourages Toni to ask her on-point question
- Disrupts marginalizing patterns that focus on “error” or behavior and focuses instead on concepts and reasoning
- Expects other children to listen and to ask questions and creates structures that support children to listen to others’ ideas
- Models and names “good questions” as an important mathematical practice
- Strategically names and highlights particular children displaying specific forms of competence
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Eliciting and interpreting students’ thinking

Modeling and explaining content

Leading group discussions

Establishing norms and routines for classroom discourse and work

Building respectful relationships with and among students
CHANGING DEMOGRAPHICS OF UNDERGRADUATE STUDENTS

- **Black**: 1990: 10, 2000: 12, 2013: 15
- **Hispanic**: 1990: 6, 2000: 10, 2013: 17
- **American Indian/Alaska Native**: 1990: 1, 2000: 1, 2013: 1

June 8, 2018
RACE/ETHNICITY OF FULL-TIME POSTSECONDARY FACULTY MEMBERS

- White: 78%
- Asian/Pacific Islander: 10%
- Black: 6%
- Latinx: 4%
- American Indian/Alaska Native: >1%
- Two or more: >1%

June 8, 2018
DEMOGRAPHIC DIVIDE IN THE U.S.: FACULTY AND UNDERGRADUATE STUDENTS

Faculty
- 78% Of Color
- 22% White

Students
- 58% Of Color
- 42% White

June 8, 2018
WHY IS THIS GAP SUCH A CRITICAL PROBLEM?

- The profession responsible for developing the primary human capital of our society should reflect our population
- Importance of students interacting with faculty members with whom they can identify
- Expanding the diversity of faculty members with whom students interact in college
- The knowledge base of the profession requires the expertise and experience of people who are diverse with respect to race, socioeconomic status, ethnicity, language, gender
Let’s review the core argument of this talk.
THE CORE ARGUMENT OF MY TALK

1. Teaching is powerful. It can do great harm. It can also be harnessed to be a positive force.

2. We must work together to make teaching a force for a more just society in which STEM fields are re-humanized and in which Black and Brown students and teachers belong (Bullock, Gholson, Goffney, Gutiérrez, Joseph, Martin)

3. This is a project that involves challenging and disrupting patterns that are structural and systemic as well as individual and transactional.
MY ASKS OF YOU

- Read literature by scholars whose work focuses on persistent marginalization in STEM fields and on ways to disrupt these patterns (e.g., Bullock, Gholson, Goffney, Gutiérrez, Hottinger, Joseph, Martin)
- Question how you represent STEM fields. Select course readings and materials that extend and challenge the representations of scholars in your field.
- Ensure that the contexts, content, and people of the examples, representations, illustrations, readings, and other media used in your courses regularly represent communities of color and non-dominant groups.
- Directly challenge deficit views of students of color and low-income students
- Explicitly surface and discuss the ways in which racism underlies many taken-for-granted and normal practices in schooling and classrooms.
- Support students and colleagues to understand their identities and roles as part of a broader system of oppression that is historical and persistent (note: this includes explicit attention to White privilege and White supremacy)
THANK YOU!

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Slides will be available on my website

https://deborahloewenbergball.com/

(“Google” Deborah Ball)
Data on slide 24:

Data on slide 40:

Data on slide 41: