Cultivating STEM Talent: Lessons from STEM Pioneers and Exemplar Institutions

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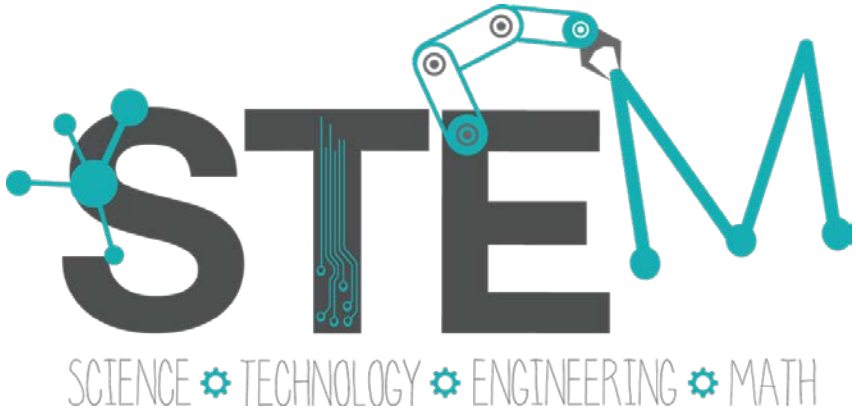
Problem

- National goal to increase the conferral of STEM degrees to broaden and diversify the STEM workforce
- Faculty are an integral component of efforts to retain students in STEM
    - Via mentorship, research experiences, & teaching
    - Broader conceptions of scientific talent likely impact faculty investment in students
    - Narrow definitions of talent prevail and likely result in a cycle of cumulative advantage for those students identified as having talent

Purpose

The purpose of this study is to explore views of talent development among institutional agents from exemplary institutions in producing STEM bachelor's degrees with implications for science education and training.



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Research Questions

1. How do STEM administrators, faculty, program directors, and pioneers in STEM identify student talent?

2. How do these institutional agents position undergraduate students for STEM success?

3. What institutional resources or policies support faculty in cultivating STEM student talent?

Guiding Perspective on Talent

----- Static -----
--- Fixed Mindset ---

---------- Fluid ----------
---------- Growth Mindset ----------

- Product of innate traits
- Born ‘gifted’ in some area or not

- Talent is a mix of innate and acquired traits
- Mediated by contextual factors

- Product of acquired traits
- Any skill can be mastered via deliberate arduous practice

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Conceptual Framework

Approaches to Identifying Talent

- Superior Grades – “A”s on tests and assignments
- Evaluate students on the basis of future potential (rather than existing skills alone)
- No single factor alone being an indicator of talent
- Dominant narrative of talent based on White male norms

Role of Institutional Agents

- Faculty & Administrators = High status individuals who occupy relatively high positions in the stratification structure of the university
- Can empower traditionally low-status students in their social development and educational attainment

Methods

Data Sources & Sample

STEM Introductory Classroom Data

- 8 institutions: 1 HSI, 1 HBCU, 6 PWI
- Focus groups with 26 STEM faculty

Case Studies at Exemplar Institutions*

- 6 institutions: 1 HBCU, 1 Tribal, 2 HSI, 2 PWI
- 20-25 STEM faculty, program directors, and administrators interviewed per campus

STEM Pioneer Data**

- 32 Pioneers across varied STEM disciplines

Data Coding & Analysis

- Open coding using the constant comparative approach
- Several iterations of coding schemes – codes expanded, defined, and refined
- Intercoder reliability = 80-85% agreement
- Qualitative software to run queries and to test hypotheses in data

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Findings: How talent is defined

Traditional Definition

- Use test scores & curved grading
- Narrow, restrictive, and place students in competition with each other
- Some use grades as proxies for students' work ethic, attention to detail, or passion

Broader Definitions

- Talent is fluid, development characteristic
- Different types of talent (ex: lab skills, class knowledge)
- About being a leader, having an inquisitive mind, asking questions, thinking out of the box, displaying comfort with ambiguous problems
- A student can struggle with grades and still be viewed as talented
- Excited to do science, persistent in the face of challenges, use existing knowledge to mentor others, use science as a means to improve society
- Coincided with the view that all STEM students should be supported to acquire greater skills and to reach their full potential
- Inclusion & talent development in the classroom = Social justice imperative

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How Talent is Defined

As a full professor in chemistry and director of a research program for STEM students explained, talented students are:

The ones that are risk takers, the ones that are willing to fall down and pick themselves up again, the ones who aren't afraid of making a fool of themselves, of looking at things differently… they have to be open to learning as opposed to [simply] memorizing and getting good grades... It's people who like puzzles and who don't mind being wrong, who know that there's a bigger payoff farther down the road. – Pioneer Data

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How STEM Talent is Cultivated

Helping students reach the peak of their potential as scholars and future STEM professionals

Individual Level

- Grant access to opportunities
- Provide mentorship and support
- Provide validation and affirmation
- Responsive to students' backgrounds and circumstances
- Position students for STEM careers or graduate school
- Targeted lab research experiences
- Introduce students to professional networks

Classroom Level

- Innovative instructional pedagogies and course formats, incorporate active learning
- Display approachability in class
- Flexibility in delivering course lessons
- Understand personal difficulties students face

Program Level

- Institutionalized programs
- Fundraised
- Sustained or cultivated leadership to carry out program mission

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How STEM Talent is Cultivated

Some faculty actively thought about how their teaching practices contribute to the academic success of students!

The first and most important lesson I've learned is to **appreciate the difficulty that some students have with the material and to make sure that they don't feel judged for the difficulty** that they're having, to express the idea that some of this material is challenging, it is different from anything that they've had before. Some of it is not intuitive, and that's okay. It's okay to struggle with it, and many people do. They won't be judged harshly for not getting it right away. — *Professor in Ecology and Evolutionary Biology, Introductory Classroom Data*

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Institutional Resources or Policies that Support Faculty in Cultivating Talent

Senior Administrators support efforts that support talent development by:

- Channeling money towards interventions
- Incentivizing teaching
- Hiring exceptional faculty who enjoy teaching
    - STEM lecturers and STEM Education researchers
- Providing course releases and peer learning assistants
- Funding Teaching and Learning Centers
    - Faculty learning communities

Institutional Resources or Policies that Support Faculty in Cultivating Talent

Strategies must be multi-level and multi-strategy!

One of the things that I pushed throughout [my career] was that we have to get this from many different levels. We have to train junior faculty. We have to try to implicate senior faculty. We have to train the next generation of post-docs and graduate students. We have to provide grant incentives. We have to provide awards. We have to provide negative reinforcement for the other ways [that reduce STEM success]. Just in every angle, I see different ways of either rewarding or discouraging the behaviors we either want or don't want respectively. – Biology Professor, *Pioneer Data*

Discussion

- Talent is expressed in a multitude of ways and is fluid rather than static

- Broad definitions of talent indicate an evolving culture of change in STEM education
    - Faculty identification with students goes a long way!

- Cultivating student talent requires professional training for faculty
    - Good teaching is a journey that improves with intentional practice
    - Role of STEM education researchers and STEM lecturers
    - Meeting students where they are to most effectively develop students

Conclusion & Implications

- A comprehensive, multi-prong approach is needed

- A key contribution of the study is actual accounts about views of talent and how practices are consistent with student talent development are changing in STEM.

Questions?

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