



Cultivating STEM Talent: Lessons from Exemplar Institutions

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Overview



National interest in institutional undergraduate talent development, how data/evidence informs organizational learning for change within institutions



Faculty and Staff examples from 11 case study institutions across the U.S.

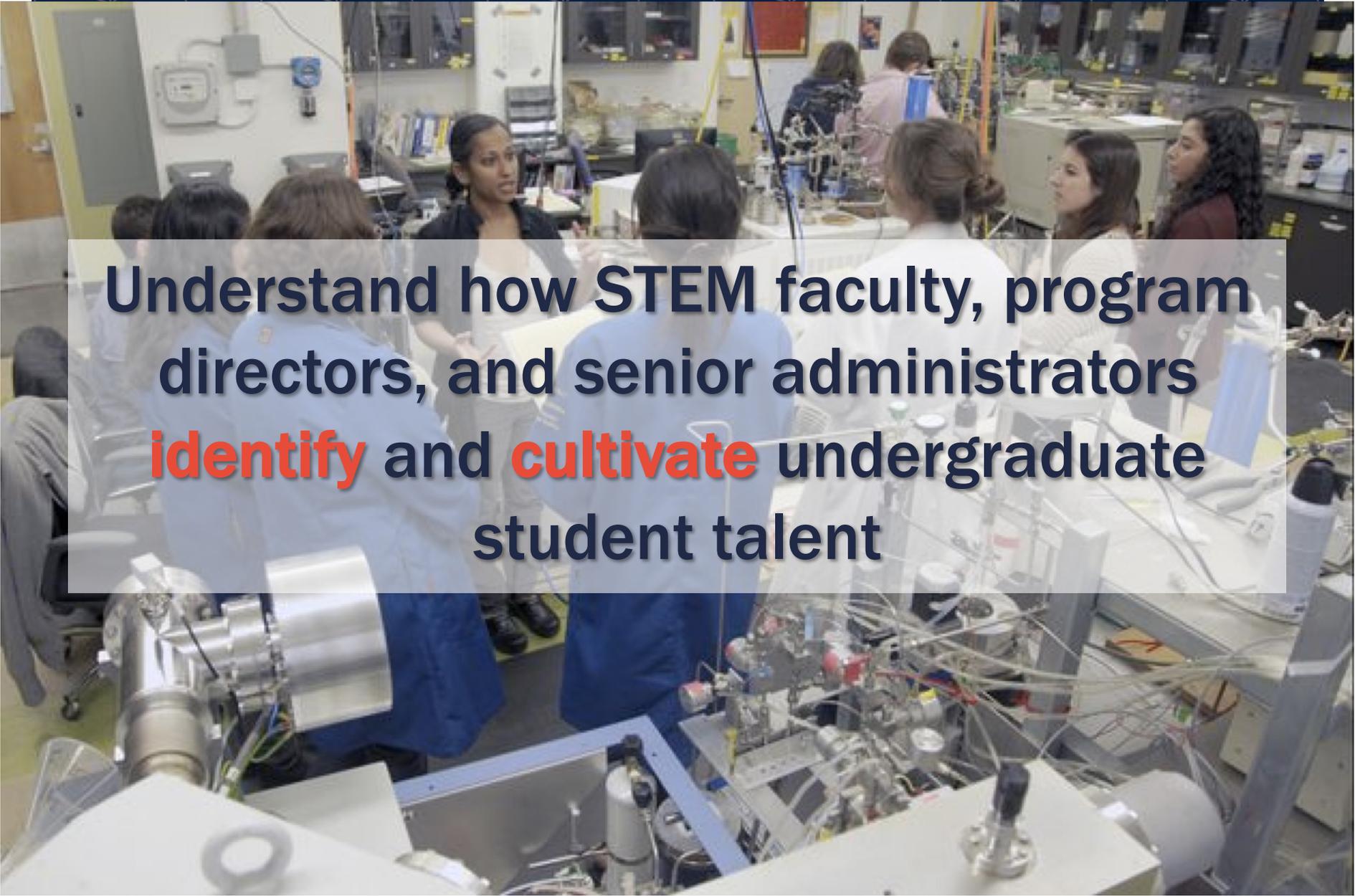


Implications for institutional STEM transformation



HERI

Purpose



Understand how STEM faculty, program directors, and senior administrators **identify** and **cultivate** undergraduate student talent

Conceptual Framework

Perspectives on Talent:

- Growth Mindset (Dweck 1999, 2008)
 - (malleable) vs. fixed (innate) mindset
- Grit (Duckworth, 2007)
 - perseverance and passion for long-term goals

Cultivating Talent:

Asset Bundles (Johnson & Bozeman, 2012)

The specific sets of abilities and resources students develop to help them succeed in educational and professional tasks

- educational endowments
- science socialization
- network development
- family expectations
- material resources

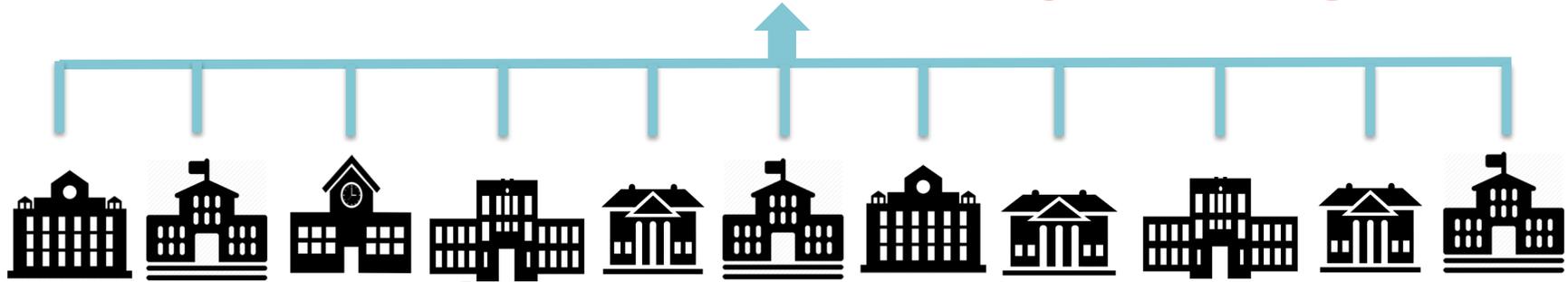
Methods



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Methods

Multiple Case Study Design



QUANT

Stochastic Frontier Analysis
→ efficiency scores →
Selection of 11 diverse institutions with high efficiency scores

SITE VISITS

web scraping →
15-25 interviews per site (faculty, senior administrators, STEM program directors)

CODING

wrote case study reports → Coded transcripts:
open coding, axial coding, team inter-rater reliability 85%

ANALYSIS

cross-case analyses using matrices, institutional reports, codes, team discussions until themes became salient

| Institutional Pseudonym | Control | MSI Status | Classification | STEM Bachelor's Degree Efficiency Score |
|------------------------------|---------|--------------------|---|--|
| Southeast State University | Public | HSI | Doctoral Universities: Highest Research Activity | .82 Latinx .53 Black .35 American Indian |
| West Coast State University | Public | HSI | Master's Colleges & Universities: Larger Programs | .83 Latinx .37 American Indian .27 Black |
| East Coast State University | Public | HSI | Doctoral Universities: Higher Research Activity | .81 All STEM |
| Southern Private University | Private | HSI | Master's Colleges & Universities: Larger Programs | .65 Latinx .35 American Indian .12 Black |
| Central Plains University | Public | Am. Indian serving | Doctoral Universities: Higher Research Activity | .96 American Indian .44 Latinx .35 Black |
| Northern Mountain University | Public | Am. Indian serving | Doctoral Universities: Higher Research Activity | .94 American Indian .75 Latinx .25 Black |
| Atlantic Southern University | Public | HBCU | Master's Colleges & Universities: Medium Programs | .89 American Indian .84 Black .52 Latinx |
| Mid-Atlantic University | Private | HBCU | Doctoral Universities: Higher Research Activity | .81 Black & All STEM |
| Western Private College | Private | PWI | Baccalaureate Colleges: Arts & Sciences Focus | .73 All STEM |
| University of the Southeast | Public | PWI | Doctoral Universities: Highest Research Activity | .79 All STEM |
| Midwest State University | Public | PWI | Doctoral Universities: Highest Research Activity | .75 All STEM |

Findings



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*How do STEM faculty, STEM program directors, and senior administrators **identify** undergraduate student talent in STEM disciplines?*

Traditional Metrics

Eagerness and Passion for STEM

**Thirst for Knowledge and Skill
Development**

Grit

Ingenuity

Acuity

Traditional Metrics

Faculty members use academic transcripts to filter research opportunities:

A lot of students come and ask to work with me and the first thing I do is I go and I look up their transcript and if their transcript is reasonably strong then I invite them to come to lab meetings and see if they still like us, you know. We discuss papers and so forth and take all the online safety classes you're required to take for working in a lab. And if they stick it out and do all that, then it shows they're really interested and then we start incorporating them into the lab. If they even fail the transcript test, what you tell them is, you know, working in a lab is going to be a lot of work and you need to get your academics in order before you take on new responsibilities.

–Biology Faculty Member Southeast State University

Eagerness, Passion, Enthusiasm

Many faculty emphasized the importance of passion and enthusiasm for STEM alongside academic skills:

Yeah. Enthusiasm is you [contact me]—you send me an email, you come to my office, you basically [are eager to learn]. Enthusiasm is, if I don't know you, you approach me and you're like, "Oh, wow. I'm interested in learning more about this field," or, "I'm interested in learning more about that [topic]." Enthusiasm is really—I guess also it's taking the initiative, being proactive.

–Biology Professor East Coast State University

Thirst for Knowledge and Skill Development

Curiosity and inquisitiveness allow students to stand out and be identified by faculty:

Are they naturally inquisitive? Do they care about digging deeper?”—those are usually the students who ask different kinds of questions. Or if I give ‘em a topic, they’ll come one day and say, “You’re talking about...water treatment—and I found this great paper. I went online..” that’s an inquisitive mind! That person is interested in learning something more.

—Department Chair and Professor of Engineering,
Mid-Atlantic University

Grit

Faculty described how student commitment and perseverance may offset poor grades in a course

Students all want to come in and do research. You can't accommodate everybody so you have to be selective to some degree...the faculty [will say], "Well I only I'm going to take an A+ student." But the ones who really understand will say, "I'm not going to do that. **I'm going to take the B student who looks like they're motivated and they're going to stick with it.** And that student winds up very often being the best...because the A student is going to do really well anyway no matter what. And that you can throw them in a whatever and they're going to rise to the top anyway just because that's who they are. **But it's the other ones, that if you just water them a little bit [to cultivate talent] then they have that perseverance [to stay in STEM], they have that grit the "stick-to-it-ness."**



–Faculty member and Director of STEM intervention program at West Coast University

Ingenuity

Faculty identify creative thinking as a strong indicator of talent

Largely [I see talent as] **being able to think creatively** about math. We had one math major who, actually unfortunately, did not end up completing her degree, but she was in my college algebra class and I had a bonus question on a test. **The answer she came up with, I thought, was more concise and better than the answer I had thought of.** I wrote on her test something to the effect of, “Are you sure you’re not a math major? Why don’t you come talk to me?” She ended up changing her major to math – I forget what it was prior to that, and was doing well before personal issues got in the way of completing college at all.

–Mathematics Professor,
Southern Private University

Acuity

Having a Fixed mindset on STEM talent

It's pretty easy to identify actually. Yeah, and the good students learn things right away, easily, quickly. They can think abstractly, they can see a problem, decompose it, put it into pieces. They understand how the components work. They understand how computing and algorithms work in any language. They pick it up easily.

–Computer Science Professor,
Southern Private University

Cultivating Talent

Science Socialization

Network Expansion

Material Resources



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Cultivating Talent

Science Socialization

Providing opportunities for students to see themselves as scientists and providing resources for students to adopt the norms, values, behaviors and social skills relevant to science careers

Science Socialization

They don't work for me. We collaborate....They're not workers. They're not slaves. They're not bottle washers. They're researchers....**we consider each other to be colleagues.** We've treated the undergraduates in the same way. They're our colleagues. They aren't an employee. They aren't someone that's there to get work done for us. They are our colleagues. **We try and treat everybody like everybody could have an idea for a paper.** Everyone could contribute to a research presentation.

–Director of a STEM intervention program at West Coast State

Cultivating Talent

Network Expansion

Faculty help students expand their social networks by building positive social capital through mentoring relationships and involvement in extracurricular activities

Asset Bundle: Network Expansion

Part of why the undergraduate research paradigm works so well is there is a direct **mentoring experience**. So when it's done well, not only is someone mentoring you in research but they really become your **best connection** for lots of things like resources and information.

–Provost at Atlantic Southern State

Cultivating Talent

Material Resources

Faculty support students through **targeted financial interventions, such as scholarships and grants, that address students' financial needs and help remove financial barriers to persist in STEM**

Asset Bundle: Material Resources

We do have a lot of **scholarship money** and we use that to help students offset their unpaid internship programs because we know that if they have that internship that they can be more successful; but again it's – often times our students don't have a lot of external resources, **so we need to find ways to help them financially** be successful in STEM.

–Dean of the College of Agriculture at West Coast University

Conclusion & Implications

- Cultivating growth mindset in students AND having a growth mindset when training students
- Faculty play a critical role in recognizing potential in undergraduate students, especially early enough in college to increase STEM degree completion
- Broader definitions of talent are not necessarily discernible without profound engagement with the individual student

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Papers and reports are available for download from project website:

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