Opportunity Structures for Preparation and Inspiration (OSPrI): Understanding Inclusive STEM High Schools

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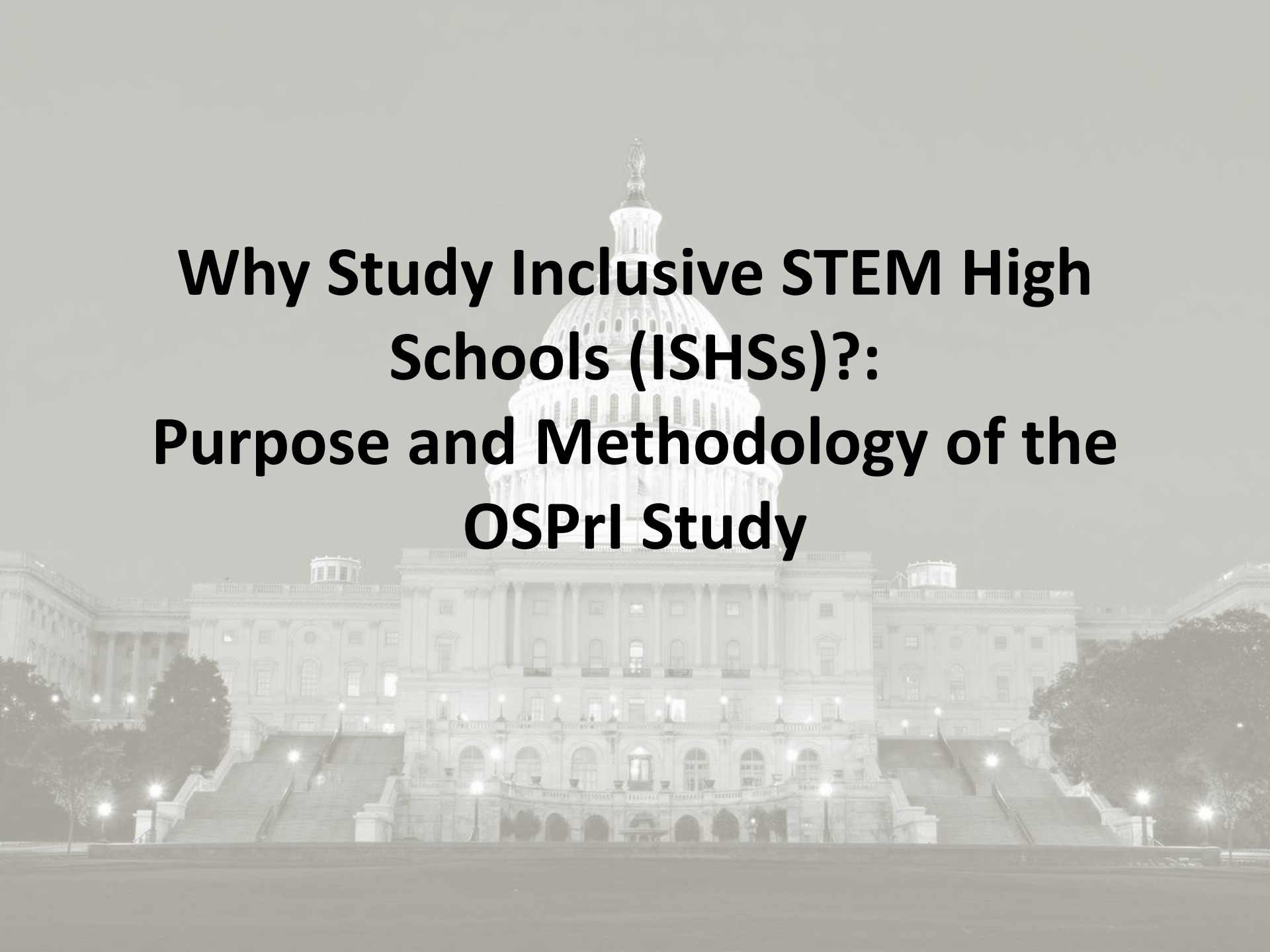

Why Study Inclusive STEM High Schools (ISHSs)?: Purpose and Methodology of the OSPrI Study

Why Study Inclusive STEM High Schools (ISHSs)?

- They are education experiments. They are innovative. But their education programs are often not well described
- They have no umbrella agency/organization; no commonly accepted definition or model
- They are built into state some STEM education plans;
- Little is known about their effectiveness
- They tackle BIG education problems: **Open STEM fields to a wide range of students**, including groups with the highest rates of growth but who are persistently excluded from STEM fields (National Academies, 2011)

OSPrI Study Purpose

The purpose of the 4-year OSPrI study is to:

- Describe 8 ISHSs through detailed instrumental case studies
- Conduct cross-case analyses to understand how a set of exemplar ISHSs are similar and different
- Build a “theory of action” for ISHSs work for students under-represented in STEM

Research Questions for Instrumental Case Studies

Instrumental case studies are a qualitative research design that allows the researcher to enter the case study site with specific questions in mind, AND be open to emergent themes (Stake, 1995; Yin, 2009, 2012).

OSPrI research questions:

1. Is there a core set of likely critical components shared by 8 well-established, “exemplar” ISHSs?
2. Are some more salient than others across all schools?
3. Are there emergent themes not initially included in the hypothetical critical components, shared across schools?
4. Eventually, is there a theory of action that explains the success of ISHSs?

Candidate Critical Components

1. STEM-focused curriculum
2. Reform instructional strategies & project-based learning
3. Integrated, innovative technology use
4. Blended formal/informal learning beyond the typical school day, week, or year
5. Real-world STEM partnerships
6. Early college-level coursework
7. Well-prepared STEM teaching staff
8. Inclusive STEM mission
9. Administrative structure
10. Supports for under-represented students

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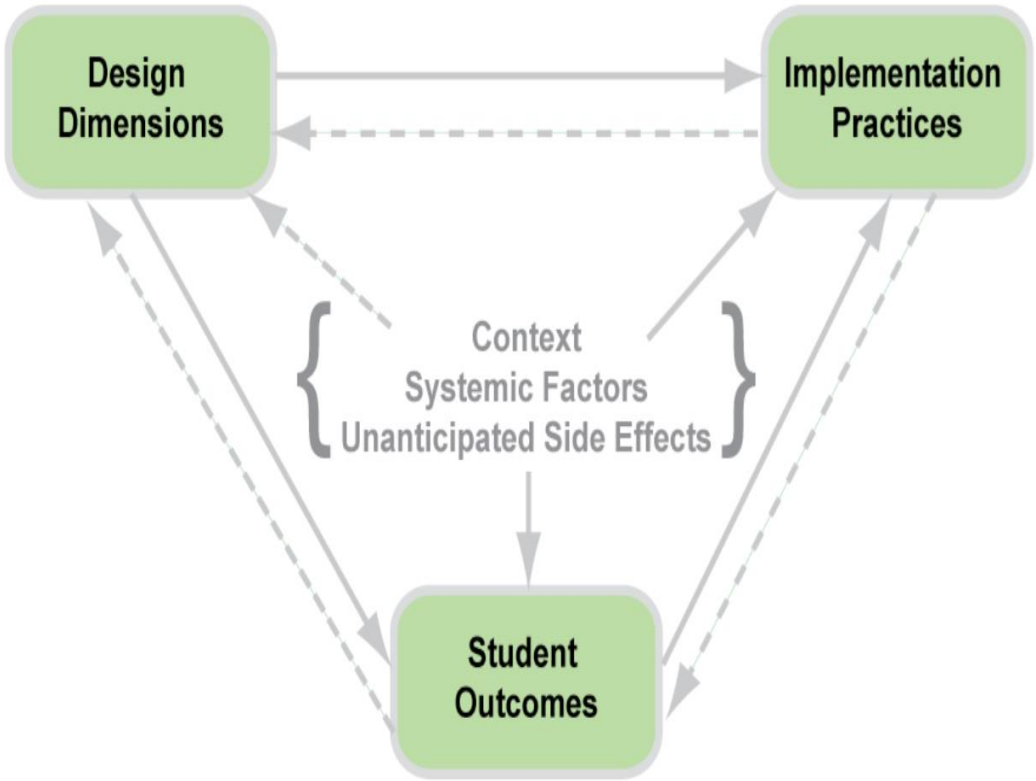
Methodology

- We searched research literature to create list of likely critical components in ISHSs.
- Located 8 exemplar ISHSs across the US. Explore school context.
- Conducted instrumental case studies of ISHSs to find evidence of 10 critical components in each Dimension. Identify emergent themes.
- Currently conducting cross-case analyses to help describe a common model.



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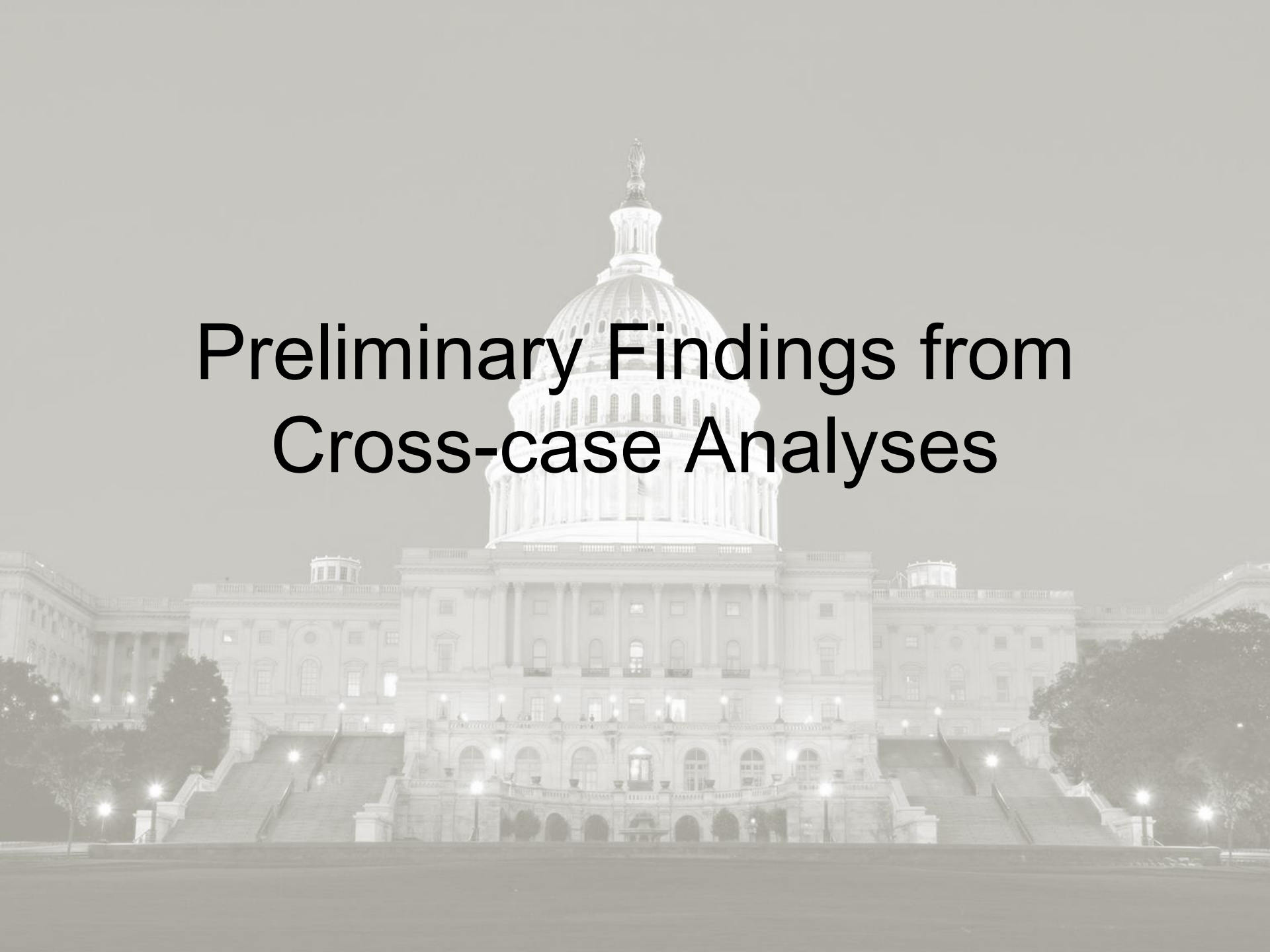
OSPrI Case Studies

School	Context and Affiliations	Diversity Indictors
Gary and Jerri-Ann Jacobs High Tech High (578 students)	Large Metropolitan Area K-12 HTH Public Charter Network	41.3% Hispanic/ Latino, 33.0% White, 13.8% Asian/Filipino/ Pacific Islander, 10.6% African American 46% Female 43.9% Socioeconomically Disadvantaged
DSST: Stapleton High School (508 students)	Large Metropolitan Area 6-12 Denver School of Science & Technology Public Charter Network	34.8% Hispanic or Latino, 27.6% White, 26.2% Black or African American, 3% Asian/ Pacific Islander 53.7% Female 44.8% Free and Reduced Price Lunch
Wayne School of Engineering (325 students)	Rural County School District NC State-level STEM Network	47.4% White, 30.8% Black, 14.5% Two or More Races, 6.8% Hispanic 47.1% Female 44.4% Free or Reduced Price Lunch
Manor New Tech High School (333 students)	Exurbia/Small School District TX State-level T-STEM Network New Tech National-level Network	44.3% Hispanic, 32.2% White, 19.0% African American, 2.4% Asian 47% Female 51.8% Economically Disadvantaged

School	Context and Affiliations	Diversity Indicators
Columbus, OH **Metro High School (Metro)** **(394 students)**	Large Metropolitan Area Partnership between Ohio State University and Batelle Ohio STEM Learning Network	54.3% White, 28.3% Black Non-Hispanic, 7.6% Asian, 3.8% Hispanic 50.2% Female 29.4% Economically Disadvantaged
Boston, MA **Urban Science Academy (USA)** **(576 students)**	Large Metropolitan Area Boston Public Schools	51.2% African American, 38.9% Hispanic, 6.8% White 45.7% Female 74.8% Low Income, 83.2% High Needs
Medical High School (MedCTE); College Prep **(639 students)**	Rural County School District Connect Ed: The California Center for College and Career	37.9% Hispanic, 22.4% White, 19.0% Asian/ Filipino/Pacific Islander, 16.4% African American 64.3% Female 49.0% Socioeconomically Disadvantaged
Chicago High School for Agricultural Science CHSAS **(565 students)**	Large Metropolitan Area Chicago Public School District	38.9% Black/ African American, 31.7% White, 24.1% Hispanic 50.3% Female 48.8% Low Income



Preliminary Findings from Cross-case Analyses

Candidate Critical Components

1. STEM-focused curriculum
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5. Real-world STEM partnerships
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Prominence Ratings of Critical Components Across 8 ISHSs

Critical Component	Inclusive STEM-Focused High School							
	A	B	C	D	E	F	G	H
1.STEM-Focused Curriculum	2.5	2	2	3	2	3	3	3
2. Reform Instructional Strategies and Project-Based Learning	3	2	1	3	1.5	2.5	2	2.5
3. Integrated, Innovative Technology Use	2.5	1	2	3	1.5	2	2	2.5
4. Blended Formal/Informal Learning Beyond the Typical School Day/Week/Year	2	1	2	3	1.5	2	1	3
5. Real-World STEM Partnerships	1	1	1	3	1.5	3	2.5	3
6. Early College-Level Coursework	1	3	1	1	2	3	1	1.5
7. **Well-Prepared STEM Teaching Staff**	3	2	2	3	2	2.5	2.5	2.5
8. Inclusive STEM Mission	2	2	3	2	2.5	1.5	2.5	2
9. **Administrative Structure**	3	2	3	3	2	3	2	2.5
10. **Supports for Under-represented Students**	3	3	3	2	3	3	1	2

The range of values for each critical component rating is 0 (not present) to 1 (low) to 3 (high). The "Total Rating" for each component is the sum of ratings for that component across all eight schools. "**" indicates those components that had a total rating of 19 or higher.

Findings – STEM-focused Curriculum

- ISHSs had more rigorous requirements for graduation than state
  - Additional mathematics and science required
  - Engineering or CTE Pathway courses required and added to STEM college prep core
- All students took same classes—little tracking
- Students expected to master material before moving on to other courses
- Mathematics was a challenge across schools

Peters-Burton, Han, & House, 2014

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Findings: Well Prepared Teaching Staff

- Hiring autonomy to achieve strong match between teachers and school mission
- Teachers had strong STEM backgrounds: undergraduate STEM, STEM teacher preparation, career changers, etc.
- Coherent, embedded professional development provided within the normal school day or week, and driven by curriculum and instruction of ISHS
- Teacher professionalism: Teachers had autonomy in the classroom and opportunities and pathways for professional advancement
- School-wide culture of collaboration: Teachers hired for ability to collaborate as this was the way things were done

Spillane, 2014

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Findings: Administrative Structure

- Varying types of organizational structures: each school was influenced by its local context, founding, and membership in a larger charter network or organization
- Relatively flat administrative hierarchies with knowledge shared among administration, teachers and students
- School leadership included a range of leadership styles, but in these *exemplar* ISHSs we have observed evidence of transformational leadership
- School norms, beliefs, attitudes, and customs developed through rituals and traditions via challenges of STEM education

Ford & Behrend, 2014

Findings: Student Supports

- Fierce commitment to mission of creating a challenging new STEM school with a diverse student body and where every student can be successful
- System of advisories, tutoring, and data and communication systems: Electronic nervous system connected personalized education
- College and career counseling: Opportunity structures amplified
- Curriculum and instruction designed to introduce students to college-level STEM and business/industry STEM to build STEM social capital

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Emergent Themes

- **Positive (STEM) school culture**: the OSPrI ISHSs all had unique, positive STEM school cultures that helped students build STEM identities, reciprocally. The ISHSs developed STEM rites of passage as students performed in challenging STEM settings meeting high expectations, that also were personalized.

- **World of work:** STEM curriculum and instruction was tied to real world contexts (early college experiences, business/industry connections, and learning activities beyond the normal school day, week or year). STEM learning was inseparable from the development of soft/non-cognitive/21st Century skills.

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Policy Implications and Next Steps

Policy Implications: ISHSs in OSPrI study are important because they show how to:

- Improve STEM teaching/learning for a wide range of students
- Produce students with a sound preparation for college and careers in any field by developing students' STEM abilities
- Provide access to a 21st century opportunity culture that promises more social mobility and a better chance to achieve in STEM fields

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Next Steps

- Develop a theory of action Use the finding in the OSPrI study to help advance a set of indicators for STEM education
- Conduct additional cross-case analyses of the 10 critical components and emergent themes
- Participate in a NSF sponsored forum on STEM indicators, contributing our data and interpretations
- Develop and pilot test an STEM inventory to be used by ISHSs or any high school that would be used to self-assess a STEM program and determine new directions for change and improvement, based upon data from the OSPrI case studies.

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Thank You

Website:

http://ospri.research.gwu.edu/

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Opportunity Structures for Preparation and Inspiration in STEM

NSF

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Graduation Rate Comparisons Across 4 States