Building Opportunity Structures for Students in STEM: A Case Study of Metro Early College High School

Edmund M. Han
The George Washington University

NARST 2014 Annual International Conference
March 30 – April 2, 2014

This work was conducted by OSPrl, with Sharon Lynch, Tara Behrend, Erin Peters-Burton, and Barbara Means, principal investigators. Funding for OSPrl was provided by the National Science Foundation (DRL 1118851). Any opinions, findings, conclusions, or recommendations are those of the authors and do not necessarily reflect the position or policy of endorsement of the funding agency.
“K-12 STEM” in US

• 2012 PISA Results – US outperformed by:
  – 22 countries in science (18 in 2009)
  – 29 countries in mathematics (23 in 2009)

• Inequity in STEM participation:
  – Women and certain minority groups: 70% of college students, but 45% of STEM degrees
  – Women: 50% of workforce, but 26% of STEM jobs
  – Black: 11% of workforce, but 6% of STEM jobs
  – Hispanic: 15% of workforce, but 7% of STEM jobs

(PCAST, 2012; “Missing from science class,” 2013)
New experiment: Inclusive STEM-focused High Schools

• “Achievement, Engagement, Pipeline”
• Experiment with innovative STEM instruction
• Targets under-represented students & no highly selective admissions criteria
• Deliberate design as a STEM school
• Rigorous STEM curricula, increased resources and time, more prepared teachers
• Scalable models for STEM schools

(NRC, 2011; PCAST, 2010)
Opportunity Structures for Preparation & Inspiration (OSPrl)

Aims of Study
• Critical components of ISHSs and initial common theory of action

Research Questions
1. Is there evidence of each of the candidate critical components in Metro’s design?
2. How are the critical components implemented? Do other components emerge?
3. What are the contextual affordances and constraints that influence Metro’s design, implementation, and student outcomes?

Methodology
• Instrumental case study approach (Stake, 2006)
• 4-day site visits; 6-person team (8 ISHSs visited)
• Surveys, interviews, focus groups, observations, artifacts
• Administrators, teachers, students, parents, external partners
Theoretical Framework: Opportunity Structures

• Introduced as alternative to theories of career development that positioned student choice as primary factor

• Social and physical access to different types of employment

• Determinants of occupational paths: home/school characteristics, peer groups, distance to work/school, informal business contacts

• OSPrI: Full range of supports that ISHSs employ to help underrepresented students move into STEM majors, jobs, careers

(Roberts, 1968, 1984)
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. Special Supports for Underrepresented Students
Metro Early College High School
Student Outcomes

Spring 2013 OGT Results for Metro, District, County, and State (% of 11th graders at or above proficient)

2013 Average ACT Scores for Metro, State, and Nation
### Post-Secondary Outcomes

#### College Enrollment Rates for Metro and Nation Classes of 2010-2011

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Class of 2010</th>
<th>Class of 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Metro</td>
<td>Nation</td>
</tr>
<tr>
<td>Total Enrolled in College at <em>Any Time During the First Year</em> after High School</td>
<td>91.9</td>
<td>68.1</td>
</tr>
<tr>
<td>Total Enrolled in 4-Year College</td>
<td>79.7</td>
<td>41.4</td>
</tr>
<tr>
<td>Total Enrolled in 2-Year College</td>
<td>12.2</td>
<td>26.7</td>
</tr>
</tbody>
</table>

What makes Metro different?

1. Alignment with inclusive school mission
2. Reaching beyond the four walls
3. Programmatic innovations that cross components
1. Alignment with Inclusive Mission

- Rigorous and Accelerated STEM Curriculum
- Project-based instruction, Mastery, & Metro Habits
- Personalized supports & scaffolded progress and complexity (OSU, internships, etc.)
- Early College Coursework & Real-world STEM Partnerships
Early College-level Coursework

• On average, students completed 5-6 OSU courses
• Metro covered all associated costs for students
• Alignment/Cohesion:
  – Immediate feedback on rigor of and level of preparation through Metro’s classes
  – Focus on developing key college-readiness skills
  – Full-time, dedicated college advisor
2. Beyond the Four Walls

- Close partnerships with local and national STEM industry leaders
- Ohio STEM Learning Network & STEMx
- Enhanced PD opportunities for teachers
  - Collaborations
  - Innovative resources
- Enhanced learning opportunities for students
  - Internships
  - Mentors & financial support
  - Robotics team
3. Programmatic Innovations: Learning Centers

• Themed educational programs, typically in junior year
  – Energy, Environment, and Economics
  – Human Body Systems: Biomedical Engineering
  – Design
  – Agriculture

• Aim: Ease the transition from high school to early college coursework for students
  – Scaffolded “on-ramping,” dedicated counseling, and safety nets for first experiences with college coursework
Crossing Components

• Joint implementation with Metro and OSU

• Partnerships with other local high schools

• Multiple types of learning opportunities
  – Strong STEM curriculum
  – Combined high school and college courses
  – Interdisciplinary connections with humanities courses
  – Experiential learning with local businesses and educational partners in the community
  – Access to real-world STEM industries and careers
Human Body Systems: Biomedical Engineering

Ohio State University Course
Bio 113
- OSU
- 5 Credits
- Cellular and Molecular Biology

Principles of Biomedical Sciences
- PLTW
- Project Based
- Intro to BioMed Sciences

Scientific Writing

Ohio State University Course
Bio 114
- OSU
- 5 Credits
- Organismal and Ecological Biology

Human Body Systems
- PLTW
- Project Based
- Intro to BioMed Sciences

Scientific Writing

Professional Research
- In the field of BioMedical Sciences

Professional Research
- Authentic Research
- Paired with a research professional

Scientific Writing
Conclusions

• Challenging STEM & early-college curriculum

• **Personalized** instruction, experiences, networking opportunities, and supports

• Students graduate **better prepared** to handle advanced STEM college-level work on their own

• Up to two years of **college credits earned** at no personal cost
Conclusions

• Such opportunity structures not likely feasible at classroom level alone

• **Cohesive alignment** of components at all levels of the school to provide unique opportunity structures

• STEM focus, educational reach, and learning opportunities that Metro structures and provides for students **extend far beyond** four walls of the school

• **Ambitious and extensive platform** for innovation
For more information:

http://ospri.research.gwu.edu