English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives

Sponsor: National Science Foundation

#ELSTEM
Scope

- ELs pre-K-12th grades
  - Promising approaches to support ELs in learning STEM
  - Role of families & communities
  - Teachers preparation & development
  - Assessments in STEM
  - Policies and practices for capacity building
- Recommendations & gaps in current research base
Definition and Distribution of ELs
(Data from Fall 2015)

Percentage of public school students who were ELs by state
9.4% of student population is ELs (4.6 million students)

- 3–21 years old enrolled in elementary/secondary school
- Native language not English
- Proficiency may limit or deny ability to achieve in English-only classrooms

ELs lack access to STEM learning opportunities

- Limited opportunity to engage with challenging, grade-appropriate science & mathematics content & disciplinary practices.
- Exclusion from rigorous science or mathematics courses, placement in remedial courses, & poor advising regarding course selection.
- Little info about ELs in technology & engineering-based instruction.
### High School Course Completion: Mathematics and Science

#### Highest Mathematics Course Completion

<table>
<thead>
<tr>
<th>Course</th>
<th>Bilingual EL Student (N=550)</th>
<th>Bilingual Not in ESL (N=3000)</th>
<th>Native English Speaker (N=16,900)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Math</td>
<td>4.8%</td>
<td>2.8%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Basic Math</td>
<td>1.1%</td>
<td>0.5%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Pre-Algebra</td>
<td>1.1%</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Algebra</td>
<td>9.7%</td>
<td>5.2%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Geometry</td>
<td>14.5%</td>
<td>9.5%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Algebra II</td>
<td>23.6%</td>
<td>17.6%</td>
<td>20.8%</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>16.3%</td>
<td>21.6%</td>
<td>24.7%</td>
</tr>
<tr>
<td>Beyond Trigonometry</td>
<td>21.2%</td>
<td>19.9%</td>
<td>22.6%</td>
</tr>
<tr>
<td>Calculus</td>
<td>2.8%</td>
<td>4.6%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Advanced Calculus</td>
<td>4.9%</td>
<td>18.0%</td>
<td>10.1%</td>
</tr>
</tbody>
</table>

#### Science Course Completion

<table>
<thead>
<tr>
<th>Course</th>
<th>Bilingual EL Student (N=550)</th>
<th>Bilingual Not in ESL (N=3000)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>No Science</td>
<td>0.2%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Integrated Sciences</td>
<td>32.7%</td>
<td>26.6%</td>
<td>23.7%</td>
</tr>
<tr>
<td>Earth Science</td>
<td>63.2%</td>
<td>57.0%</td>
<td>63.8%</td>
</tr>
<tr>
<td>Biology</td>
<td>89.6%</td>
<td>93.3%</td>
<td>93.9%</td>
</tr>
<tr>
<td>Chemistry</td>
<td>52.0%</td>
<td>72.4%</td>
<td>70.4%</td>
</tr>
<tr>
<td>Physics</td>
<td>26.8%</td>
<td>44.5%</td>
<td>36.5%</td>
</tr>
<tr>
<td>Any AP, IB, or Honors</td>
<td>11.8%</td>
<td>29.3%</td>
<td>20.1%</td>
</tr>
</tbody>
</table>

- ≈5% ELs have no math compared to 2.4% of native speaking peers
- ≈5% enrolled in advanced courses → less than half of other peers

- Science does not have same linear progression as mathematics
- ELs less likely to take science courses overall

Data from HSLS:2009 High School Transcript Study

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Classification and Reclassification

- Classification & reclassification of ELs complex
  - Varies across states & even across districts within states
  - No common definition of ELs & agreement on proficiency standards
  - Proficiency in content achievement as criterion for language proficiency is problematic

- Reclassification challenging
  - Too-early: continued support for success needed & w/out may see attrition in long run
  - Too-late: limited access to STEM learning
  - Common practice: exclude recently designated English-proficient ELs from EL accountability group
Clear & consistent designations are needed

- Reduce misperceptions of ELs’ proficiency in STEM academic achievement
- Enable deeper understanding of
  - academic achievement
  - what program models & instructional strategies work best
  - specific approaches work best for EL subgroups under specific conditions
Policies at *ALL* levels facilitate or constrain STEM teaching/learning opportunities:
- Funding
- Accountability
- Assessment
- District organization
- Program models
- Curriculum
- Staffing

Who’s responsible for ensuring access and equity for ELs in STEM?
Recommendation 1: Evaluate current policies, approaches, and resources

Federal Agencies
- Evaluate research & development funding allocation
- Enhance efforts that foster pipeline & training programs to increase # of qualified teachers

States / Districts
- Evaluate EL definition
- Include proper specification of entrance/exit procedures
- Examine policies & procedures for implementing state criteria

States
- Evaluate policies associated with:
  - Timing of large-scale state assessments & waivers
  - Frameworks for teacher certification
  - Distribution of financial & human resources

District Leaders & School Personnel
- Examine program models & EL placement in STEM courses
- Preparation of teachers
- Opportunities for teacher collaboration & professional development
- Distribution of financial & human resources

Schools
- Evaluate ELs’ success in STEM classes
- Quality of STEM classroom instruction
- Qualifications of teachers hired
- Professional development opportunities
- Resources allocated to STEM learning

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Recommendation 1: Federal Agencies

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Recommendation 1: States/Districts

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Recommendation 1: States

Evaluate policies associated with:

- Timing of large-scale state assessments & waivers
- Frameworks for teacher certification
- Distribution of financial & human resources
Recommendation 1: District Leaders & School Personnel

• Examine program models & EL placement in STEM courses
• Preparation of teachers
• Opportunities for teacher collaboration & professional development
• Distribution of financial & human resources
Recommendation 1: Schools

- Evaluate ELs’ success in STEM classes
- Quality of STEM classroom instruction
- Qualifications of teachers hired
- Professional development opportunities
- Resources allocated to STEM learning
Recommendation 2: Develop high-quality framework to identify and remove barriers

- Identify and enact norms of shared responsibility
  - Within district central offices and within schools
  - Developed by teams of district and school leaders

- Take active role in collecting and sharing resources across schools and districts

- Continuously evaluate, monitor, and refine policies to ensure ELs’ STEM learning outcomes comparable to never-EL peers

States

Districts and School Leaders

State/District/School Leaders

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Building State Capacity to Support Districts to Serve All ELs

Quality Instruction for ELs
- Key Principles for EL Instruction
- Academic and ELD Standards
- Academic Discourse
- Cultural and Linguistic Sustainability
- Instructional Framework
- Scaffolding
- Integrated ELD
- Designated ELD

Inquiry-Driven Data Analysis
- Demographic and Performance Data
- Surveys, Focus Groups
- Interviews
- Classroom Observations/Shadowing
- Professional Learning Assessment
- Essential Elements Assessment
- Policy Review

Leadership and Systems Improvement
- Standards, Assessment, & Accountability
- LEA Plan & Resource Deployment
- Title VI requirements, State ESSA Plan
- Teacher Credentialing Requirements
- State EL Policy & Practice Framework
- Stakeholder Engagement

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Policy Strategies

California English Learner ROADMAP

Blueprint for English Language Learner Success

English Learners Task Force

May 2018

SUMMATIVE REPORT
California English Learner Roadmap

Developing English learner (EL) students’ linguistic and academic capacities is a shared responsibility of all educators across the system.

**Principle 1: Assets-Oriented and Needs-Responsive Schools**
- **School climate is inclusive and safe**
- **Educators collaborate to support ELs with disabilities**
- **Instruction is responsive**
- **Schools build strong partnerships with families**
- **Learning builds on linguistic and cultural assets**
- **Instructional materials support intellectual engagement and language development**
- **Assessments are culturally and linguistically valid**
- **Capacity-building fosters systemic EL support**
- **Leadership is committed to EL achievement**
- **School system provides adequate resources to support EL needs**
- **School system has a coherent approach to EL learning**

**Principle 2: Intellectual Quality of Instruction and Meaningful Access**
- **EL students are provided language development program choices, including multilingual options**
- **Instruction is scaffolded**
- **Home language is used as a foundation**

**Principle 3: System Conditions that Support Effectiveness**
- **Learning is aligned across grades and systems**
- **Schools provide extra time and support for EL students**

**Principle 4: Alignment and Articulation Within and Across Systems**
- **Developing EL learners must engage in meaningful school experiences that are aligned across grades and systems**
- **School system has a coherent approach to EL learning**

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Actions Taken by Districts Transforming STEM Learning for ELs

- Examine ELs’ access to and performance in STEM
- Frame efforts around an ambitious vision for ELs and guiding principles for quality instruction
- Share responsibility across their systems
- Design/implement structures that afford multiple and diverse opportunities to integrate language & content
- Consider appropriate PD for teachers
- Build partnerships
- Think flexibility about fiscal & human resources
- Communicate progress & results
Capacity Building: District/School Level

Components of Continuous Improvement Efforts

Organizational Culture
- District and School Leadership
- Data-Informed Decision Making
- Culture of Collaboration
- Community and Family Engagement

Educator Capability
- Instructional Vision
- Instructional Frameworks
- Programs and Staffing
- Professional Learning

Policy and Management
- Fiscal Resources
- Human Resources
- Extended Supports
- Monitoring and Guidance

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Organizational Culture

• Local norms, routines, & practices that shape district/school culture
• Expectations for educator professionalism, collaboration, & reflection

• **Components**
  – District and School Leadership
  – Data-informed Decision Making
  – Culture of Collaboration
  – Community and Family Engagement
Educator Capability

• Educators’ beliefs & expertise influence ability to implement curriculum, strategies, & other practices

• Components
  – Instructional Vision
  – Instructional Frameworks
  – Programs and Staffing
  – Professional Learning
Policy & Management

• Appropriate funding, resources, scheduling, staffing, & allocation of responsibility

• **Components**
  – Fiscal Resources
  – Human Resources
  – Extended Supports
  – Monitoring and Guidance
District Systemic Improvement Plan
Development Approach

Quality Instruction for ELLs
- Key Principles for ELL Instruction
- Academic and ELD Standards
- Academic Discourse
- Cultural and Linguistic Sustainability
- Instructional Framework
- Scaffolding
- Integrated ELD
- Targeted ELD

Inquiry-Driven Data Analysis
- Demographic and Performance Data
- Surveys, Focus Groups
- Interviews
- Classroom Observations/Shadowing
- Professional Learning Assessment
- Essential Elements Assessment
- Policy Review

Leadership and Systems Improvement
- Vision for ELL Success
- Language Development Approach
- Educator Competencies
- High-Leverage Strategies

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District Systemic Improvement Plan Development Approach

**Vision for ELs in STEM**

**Theory of Action**
- Strategic Objectives
- High-Leverage Strategies

**How our district will prioritize and carry out improvements for ELs in STEM**

**Key Components**
- Language Development Approach
- Core Educator Capacities
- Instructional Models

**What our district will do to improve ELs’ teaching and learning in STEM**

**Oversight**
- Milestones
- Communication Strategies

**How our district will monitor and evaluate plan implementation and effectiveness**

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District Systemic Improvement Plan
Development Approach

• Vision for EL Success in STEM
• Language Development Approach
• Instructional Program Models
• Core Educator Competencies
• Professional Learning Plan for All Educators

Drivers

Theory Of Action
• If...
• Then...

Implementation Plan
• Strategic Objectives
• High-Leverage Strategies

Milestones/Outcomes
• Implementation Targets
• Indicators

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District Systemic Improvement Plan
Development Process

Data Gathering & Analysis
- Demographic & performance data
- Surveys and EL shadowing and/or classroom observations

Preliminary Recommendations
- Drawn from assessment of practices & policy

Drafting the Plan
- Vision
- Language Development Approach
- Program Models
- Educator Competencies
- Professional Learning Plan
- Theory of Action
- Objectives, Action Steps, Milestones
- Oversight Structure

Vetting & Refining the Draft Plan
- Stakeholder input and feedback

Plan adopted by Board
Actions Taken by Districts Transforming STEM Learning for ELs

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- Consider appropriate PD for teachers
- Build partnerships
- Think flexibility about fiscal & human resources
- Communicate progress & results
School Capacity Example: Manhattan Bridges

Seven Design Elements

1. Unified Language Development Framework/Approach
2. Ongoing and intentional assessment with follow-through
3. Intensive social-emotional support
4. Passionate, strategic, and mission-driven leadership
5. Strategic staffing and teacher development
6. Carefully orchestrated structures
7. Strategic family and community partnerships
School Capacity Example: Unified Language Development Approach

Policy:
• Integrate language development and STEM
• Spanish and English development throughout STEM curriculum

Practice:
• Regular collaboration between ESL and STEM teachers
• STEM is the driver with strong linguistic supports
• Language-rich environments throughout the school
• Students draw from assets in the two languages in making sense of what they are learning or to express their thoughts
School Capacity Example: Family & Community Partnerships

To offer students experiences aligned to their STEM focus, Manhattan Bridges works with partners to:

- Bolster the academic and extracurricular opportunities they offer to students
- Offer college-level courses, so that students often graduate with college credits
- Provide mentoring or internship opportunities (Cornell University’s Hydroponics Program and Internships, paid internships for students)
- Provide intensive college counseling and guidance including college visits, application support, and mentorships
School Capacity Example: Mission-Driven Leadership

Leaders develop an infrastructure based on shared values:

• Ambitious vision and mission that guides ALL decisions
• Strong sense of pride in & respect towards ALL cultures & cultural ways of knowing in STEM
• School community:
  – Holds mindset of Continuous Improvement
  – Shares responsibility for students’ success in STEM
  – Is highly attuned to students’ needs & capacities in STEM
Recommendation 2: Develop high-quality framework to identify and remove barriers

- Identify and enact norms of shared responsibility
- Within district central offices and within schools
- Developed by teams of district and school leaders

- Take active role in collecting and sharing resources across schools and districts

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UPCOMING ACTIVITIES

• Webinar Series
  – Feb 22: Large-scale & Classroom Assessment

• Release Events
  – DC: February 12, 2019

FIND OUT MORE

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