

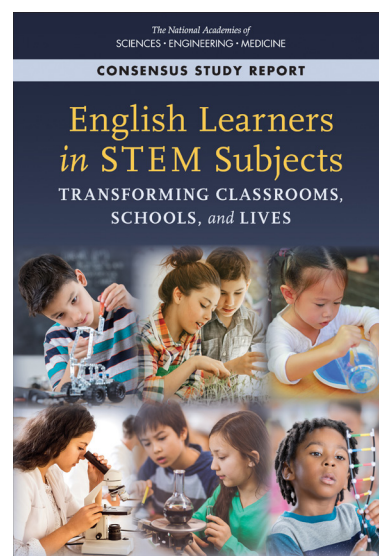
English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives

Highlights for School Leaders and Educators

English learners (ELs) comprise a diverse and talented pool of learners; they bring valuable perspectives and resources to science, technology, engineering, and mathematics (STEM) classrooms that reflect their experiences with their home languages, homes and communities, as well as STEM schooling in other countries. Yet, many of these students' lack access to rigorous STEM learning opportunities, in part due to incorrect assumptions that English proficiency is a prerequisite for students to learn STEM content.

English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives (2018), a report from the National Academies of Sciences, Engineering, and Medicine, emphasizes the importance of teaching language and STEM content in an interconnected way and identifies factors that affect ELs' access to rigorous, grade-appropriate STEM content learning opportunities and their success in STEM.

The report presents the considerable evidence that ELs can participate in, contribute to, and succeed in STEM subjects with appropriate curricular and instructional support. Organizing schools and equipping teachers so that all students, including ELs, have opportunities to reach their full potential in STEM requires changes in classrooms and schools. These changes can transform the lives of students. This brief highlights information and recommendations from the report relevant to school leaders and educators: principals, teacher leaders, teachers, counselors, librarians, and after-school coordinators.



ENGAGING ENGLISH LEARNERS IN STEM

STEM classrooms can provide rich contexts for learning in the disciplines while also developing students' proficiency in English. In fact, language is an integral part of the practices of each of the STEM disciplines. **English proficiency is not a prerequisite for engaging in rich STEM learning. However, educators need to use instructional practices that promote both disciplinary learning and language learning.** One promising strategy is to draw attention to the patterns of language within STEM content. By explicitly focusing on the language used while teaching STEM concepts and practices, educators can raise student awareness about how language is used in the disciplines. This helps ELs connect language and meaning, without reducing the level of complexity of the content.

ELs benefit when STEM learning environments enable them to use their full range of meaning-making resources derived from their experiences (e.g., their home languages, families, and communities), and allow them to use different modalities and representations (e.g., pictures, diagrams, gestures) to communicate their thinking, solutions, or arguments. Permitting ELs to use imprecise (i.e., everyday) language is important, especially when they are exploring a concept or

discussing a problem in small groups. As ELs' disciplinary-specific ideas become more sophisticated, specialized language becomes more appropriate. The use of multiple modes of communication is not only beneficial for ELs, but also central to engaging in STEM disciplinary practices.

Teachers' attitudes, beliefs, and expectations about ELs' capacity for grade-appropriate STEM learning are critical factors that influence how they encourage engagement. **When teachers have positive expectations and beliefs about the capabilities of ELs, they are more likely to provide meaningful STEM learning opportunities for them.** Grade-level expectations for ELs in STEM subjects are maintained by using research-informed instructional strategies, such as building on students' cultural and linguistic assets and connecting their prior knowledge to new learning, purposeful and embedded language instruction, and formative assessment.

Positioning ELs as competent members of the classroom community is important for their STEM engagement. Teachers play a key role in this positioning. When teachers group students in ways that provide ELs with regular opportunities to share their ideas and engage in productive discourse and interactions with others, positive social interactions among peers are fostered. In this way, they are positioned as capable participants with rights and duties in classroom social interactions, and such efforts have been found to both impact ELs' views of themselves as learners and their achievement in STEM subjects.

BUILDING SCHOOL CAPACITY

Fully engaging ELs in STEM requires attention to school level capacity, not just individual classrooms. **School leaders will need to consider multiple strategies for building capacity. These strategies might include moving and reassigning staff appropriately, investing in the capabilities of existing staff, and fostering a culture of collaboration.** Building school capacity requires explicit attention to recruiting and retaining instructional staff (teachers and paraprofessionals) with STEM expertise who can integrate ELD in content instruction, and ideally who are bilingual. This includes creating structures that emphasize a school culture of shared responsibility between ELD/ESL teachers and STEM content teachers for EL instruction and learning. Therefore, school leaders should ensure that teachers with content certification are working with those with language expertise to co-construct and/or co-teach lessons that provide scaffolds for ELs and are collaborating with paraprofessionals to ensure instructional alignment.

It is also important to collect systematic information about ELs level of access to STEM coursework and content. Therefore, **in building capacity, school instructional leadership should develop ways to identify problems with equitable access to courses and high-quality learning opportunities in STEM.** School counselors are critical staff members to ensure proper placement of ELs in STEM courses and in classrooms with teachers or teams of teachers who are well-equipped to meet their needs.

Building school capacity also includes a commitment to investing in the professional development of all teachers. As the newer content standards call for both sophistication in STEM learning as well as in English, teachers need guidance on how to attend to disciplinary content and language simultaneously. This shift necessitates that all preK–12 educators engage in rigorous, standards-aligned content and language instruction; therefore, the development of capacity to serve ELs in STEM subjects is a critical issue for ESL, bilingual, and content area teachers.

DESIGNING PROFESSIONAL LEARNING

Although many promising instructional strategies exist for supporting simultaneous content learning and language learning, most teachers of STEM subjects have not received adequate preparation to deliver on this approach. A number of effective strategies for professional learning are available to help prepare teachers at all levels to challenge and support ELs to thrive in grade-appropriate STEM content classrooms. **Teachers benefit from both formal and informal opportunities to develop expertise to serve ELs in STEM, including on-the-job collaboration with colleagues.** One example is shared professional

development (PD) for teachers of STEM subjects and ESL teachers that allows them to collaborate and share their expertise with each other. Teachers who acquire ESL certificates through ELD-focused PD can mentor their colleagues on how to integrate STEM and ELD instruction.

In addition, targeted professional learning can also effectively address the biases that administrators and teachers of STEM subjects may bring to their work with ELs. When provided with opportunities to examine their own cultural and linguistic backgrounds and self-perceptions in their work with ELs in STEM, teachers are more likely to recognize the assets ELs' bring to their classrooms, which leads to positive STEM outcomes for ELs.

CONNECTING WITH FAMILIES AND COMMUNITIES

Students are members of families and larger social communities that shape their knowledge and interest in school and in STEM. And those families and communities are resources that can bolster efforts by schools to engage ELs in STEM learning. It is essential for educators to understand that all children, irrespective of their home culture and first language, arrive at school with rich knowledge and skills that have great potential as resources for STEM learning. **When teachers of ELs engage with families during STEM activities, they are more likely to be sensitive to and have an appreciation for the cultural and linguistic differences of their EL students, and work to improve communication and understanding.** Moreover, ongoing interaction with families can increase teachers' comfort working with families around STEM content learning.

Teachers and schools also play a central role in fostering collaboration with parents to support ELs, and persistent family-school connections are essential for promoting ELs' long-term educational attainment. Furthermore, teachers' attitudes about race, ethnicity, language, and socioeconomic status are critical factors that influence the degree to which caregivers become involved in their children's schooling. **When the disciplinary understanding already present in the EL's home is acknowledged as a viable resource to be leveraged in the classroom, caregivers can be stakeholders in their child's education beyond conventional roles for involvement** (i.e., checking homework, attending open houses, participating in parent-teacher conferences, and joining parent-teacher associations).

RECOMMENDATIONS

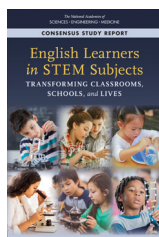
The report offers a set of recommendations to guide the efforts of policymakers, state, district, and school leaders, as well as educators, as they work collaboratively to support ELs' learning in STEM subjects. Below are the key recommendations that are specific to school leaders and educators.

RECOMMENDATION 1: Evaluate current policies, approaches, and resources that have the potential to negatively affect ELs' access to STEM learning opportunities, including classification and reclassification, course-taking, classroom instruction, program models offered, professional development, staffing, and fiscal resources, etc.

- District leaders and school personnel should examine (a) the program models and placement of ELs in STEM courses with particular attention to grade bands as well as issues associated with overrepresentation of ELs in remedial courses, (b) preparation of STEM teachers with attention to schools with large EL populations, (c) the opportunities for teacher collaboration and professional development, and (d) the distribution of financial and human resources.
- Schools should evaluate ELs' success in STEM classes, the quality of STEM classroom instruction and the positioning of ELs in the classroom, the qualifications of teachers hired, the professional development opportunities offered to teachers, and the resources (e.g., time and space) allocated to STEM learning.

RECOMMENDATION 2: Develop a high-quality framework to identify and remove barriers to ELs' participation in rigorous STEM learning opportunities.

- District and school leaders should identify and enact norms of shared responsibility for success of ELs in STEM both within the district central office and within schools, developed by teams of district and school leaders associated with STEM and ELD/ESL education.
- Leaders in states, districts, and schools should continuously evaluate, monitor, and refine policies to ensure that ELs' STEM learning outcomes are comparable to their never-EL peers.



English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives (2018)

Available:

<https://nationalacademies.org/ELinSTEM>

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For More Information . . . This Highlights for District and School Leaders was prepared by the Board on Science Education based on the Consensus Study Report *English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives* (2018). The study was sponsored by the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the National Academies Press, (800) 624-6242; <http://www.nas.edu/ELinSTEM>.

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