5th-grade science intervention focuses on English language learners

WHAT THE STUDY SAYS

At the end of the first of three years, a curriculum and professional development intervention for 5th-grade students with a focus on English language learners had a positive, significant effect on student achievement in science for all student groups on the researcher-designed assessment and positive, significant effects on the state science assessment for non-ELLs and former ELLs. With continued positive results over the remaining two years of the intervention, student performance in science has the potential to improve 38% over the annual expected gain.

Study description

Researchers developed a three-year intervention called Promoting Science Among English Language Learners (P-SELL) to address science achievement, particularly for 5th-grade English language learners. Sixty-six schools in three diverse districts in a

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single state in the Southeastern U.S. were randomly assigned to either the treatment or control group. Over 250 teachers and more than 6,000 students participated in the study.

This research report measures the effects of the intervention on both researcher-specific and high-stakes state assessments for current, former, and non-ELL 5th-grade students. Positive effects were evident for all groups on both assessments ($d = 0.25$ on researcher-developer assessment and $d = 0.15$ on state science assessment).

Questions

Researchers sought to answer an overarching question and two subquestions.

- What was the effect of the intervention on 5th-grade students' science achievement compared to current practice?
  - Was the intervention beneficial, on average, for students?
  - Was the intervention beneficial for ELLs, recently reclassified ELLs, former ELLs, and non-ELLs?

Methodology

To address the gap in science achievement among elementary students, researchers designed a randomized control study to examine the effects of

At a glance

In a randomized control study, researchers examined the impact of an inquiry-based science curriculum for 5th-grade English language learners (ELLs), recently reclassified ELL students, and non-ELL students coupled with teacher professional learning in science content, content-specific pedagogy, and language acquisition on two distinct measures of science achievement. The intervention had a positive and significant effect for all students at the end of the first year of the three-year intervention.

THE STUDY

Llosa, L., Lee, O., Jiang, F., Haas, A., O'Connor, C., Van Booven, C., & Kieffer, M. (2016). Impact of a large-scale science intervention focused on English language learners. *American Educational Research Journal, 53*(2), 395-424.

P-SELL, a curriculum and professional development intervention, to improve the science achievement of 5th-grade students, particularly English language learners. The study's design addressed numerous limitations in previous studies by expanding the number of subjects and implementation sites, including current, recently reclassified, and past ELL students, and assessing achievement on both a study-specific and high-stakes state assessment.

P-SELL included a yearlong standards-based, inquiry-oriented science curriculum for 5th-grade students along with consumable student materials, science supplies, and additional student materials online that aligned with the state science standards.

The curriculum scaffolded its

WHAT THIS MEANS FOR PRACTITIONERS

This study confirms that well-designed curriculum, especially focused on addressing the specific language learning needs of ELL students, coupled with effective professional development that supports implementation of the curriculum improves student academic success for all students.

For practitioners of professional learning, the incorporation of research-based principles of professional development illuminates the significance of applying Learning Forward's Standards for Professional Learning (Learning Forward, 2011) in the design and implementation of learning experiences for teachers.

Specifically, researchers identify:

- Content and language development and content-specific, reform-oriented pedagogy as primary focus for teacher professional learning **(Outcomes)**;
- Active engagement of teachers within the workshops **(Learning Designs)**;
- Collective participation of the entire 5th-grade teaching team at each school to build coherence within instruction and content **(Learning Communities** and **Outcomes)**;
- Duration over a school year **(Implementation)**;
- Extended time for planning, exchanging ideas, and sharing resources and stipends for teacher participation **(Resources)**;
- Teacher reflection related to implementation within and across schools **(Learning Designs)**; and
- The engagement of district science curriculum leaders in designing and implementing the professional learning **(Leadership)**.

What is unclear regarding the professional development is how data about teachers, students, and schools were used in the design and implementation of the professional learning **(Data)**, how leaders at the school level were engaged in and supportive of the intervention **(Leadership)**, and how teacher implementation was supported **(Implementation)**.

Focusing teacher professional learning on developing content knowledge, language acquisition, and application of content-specific, reform-oriented pedagogical practices aligned with district curriculum and state standards increases student academic achievement on both the high-stakes state and researcher-developed assessments in diverse schools and school systems. Professional learning specifically designed and implemented for defined purposes, as demonstrated in this study, has positive effects on student learning.

Reference

Learning Forward. (2011). *Standards for Professional Learning.* Oxford, OH: Author.

approach using a gradual release model to move students from a structured to an open-ended approach to science and encouraged students to design applications of their learning and further investigations in everyday situations.

Teachers received extensive curriculum materials that included information to support content knowledge, content-specific pedagogy, curriculum implementation, differentiation, and supplemental online resources focused on mastery of the science standards.

All 5th-grade teachers and their students in the treatment schools participated in a total of five days of professional development over a year in both summer and school-year workshops. The professional

development focused on developing teachers' content knowledge, content-specific pedagogy, language acquisition knowledge and skills, and capacity to implement the curriculum.

In each of three districts, researchers randomly selected 22 schools — 12 with ELL populations exceeding the district mean and 10 with ELL populations below the mean to ensure that the student population within the study represented the participating districts.

Schools were then randomly assigned to treatment and control groups, and no significant difference between the two groups of schools was evident at the beginning of the school year. Control schools continued their current approach to science instruction, and treatment schools implemented P-SELL. One district was classified as urban and two were urban/suburban. Student populations in each district were demographically, linguistically, and economically diverse.

Analysis

Researchers applied a sequence of multilevel models to answer the research questions. They nested data into three levels — students nested in teachers, and teachers into schools. They examined outcome variables for the two assessments to answer the overall question and used subgroup analyses to measure the effects for each language-proficiency group.

Researchers classified students into four language groups: currently classified as ELL and receiving services (7.8% of students); recently reclassified students who have exited the English as a Second Language program and are being monitored for two years (3.7%); former ELL students who have exited the program and are no longer being monitored (11.6%); and non-ELL students, those who have never received English as a Second Language services (76.9%).

Students completed two measures of science achievement: the high-stakes state science assessment that accounted for a portion of each school's overall grade for the state accountability program and a researcher-developed assessment using released items from NAEP and TIMSS assessments.

The latter, a 25-item assessment including both multiple choice and short-response items, was briefer than the multiple-choice item state science assessment and aligned strongly with the P-SELL curriculum. Students completed one form of the researcher-developed assessment as a pretest and the state assessment and another form of the researcher-developed assessment as a post-test.

Results

At the end of the first year of the intervention, students in the treatment group performed better than students in the control group on the researcher-developed assessment of science achievement. Results of both measures were statistically significant (state science assessment $d = 0.15$; researcher-developed assessment ($d = 0.25$).

Subgroup analyses indicated that P-SELL has a positive and significant effect for ELLs ($d = 0.35$, $p < .001$), recently reclassified ELLs ($d = 0.41$, $p = .020$), former ELLs ($d = 0.28$, $p < .001$), and non-ELLs ($d = 0.24$, $p < .001$) on the researcher-developed assessment. An effect size of 0.13 is considered a mean effect size for interventions that focus on curriculum or instruction, and 0.08 is the median effect size.

As a result, this study provides strong experimental evidence that an intervention focusing on inquiry-based science curriculum and language development coupled with professional development can be implemented successfully in a variety of settings and positively and significantly affect student science achievement.

On the state science assessment, P-SELL produced significant effects for non-ELLs ($d = 0.16$, $p < .001$) and former ELLs ($d = 0.18$, $p < .015$), and positive, yet not statistically significant effects for recently reclassified ($d = 0.13$, $p < .58$) and ELL students ($d = 0.12$, $p < .247$). These results may be explained, according to the researchers, based on the proximal versus distal relationship of the assessments to the intervention or the different nature of the assessments.

Overall, given the positive effects in the first year for all subgroups, extrapolated data for the full three years of the intervention suggest that, after three years, students participating in P-SELL may outscore nonparticipating peers by as much as 38% when normative gains on state assessments are considered.

Limitations

Researchers reported no limitations within this article, primarily because the design of this intervention and its study specifically addressed limitations in previous, similar studies.

One evident limitation is an absence of information on degree of implementation of the curriculum and pedagogical practices. While it is possible to assume that implementation of the curriculum and new instructional practices was high, researchers provide no evidence regarding implementation, challenges teachers and school leaders experienced with implementation, and strategies for addressing the challenges. Information regarding implementation as the study continues will strengthen the usefulness and generalizability of the intervention.

Understanding the interaction effects among curriculum design and implementation, professional development to strengthen teacher content knowledge, instructional practices, and student academic success will further extend the applicability of the intervention so that it can be implemented at scale. In addition, as the intervention continues into subsequent years, implementation with fidelity has the potential to extend and expand positive effects. ■