IES Institute of Education Sciences

Science Teachers Learning through Lesson Analysis (STeLLA®)

Intervention Brief | Primary Science Topic Area

WHAT WORKS CLEARINGHOUSE™
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Large numbers of U.S. students lack proficiency in science, and students from different racial/ethnic and socioeconomic groups show disparities in science achievement. Science knowledge and skills are important for both academic and workplace success, and a variety of interventions have been developed to improve student achievement in science. These interventions include professional development programs for teachers that are designed to change teachers' content knowledge or classroom instruction in science. *Science Teachers Learning through Lesson Analysis (STeLLA®)* is a professional development program, developed by BSCS Science Learning, that aims to improve students' science achievement by improving teachers' science content knowledge and their abilities to (a) explain science concepts to students, (b) clearly identify to students the science concepts used in student learning activities, and (c) engage students in thinking about science.

Participating teachers learn from postsecondary science faculty to improve their knowledge of the science content areas they will teach during the school year; become familiar with *STeLLA®* lesson plans and instructional strategies; work in study groups led by *STeLLA®* professional development leaders to analyze videorecorded examples of experienced teachers implementing *STeLLA®* lesson plans and strategies; and videorecord their own classroom instruction and meet with their study group to analyze one another's videorecorded lessons.

This What Works Clearinghouse (WWC) intervention report, part of the WWC's Primary Science topic area, explores the effects of *STeLLA®* on science achievement. The WWC identified three studies of *STeLLA®*. One of these studies meets WWC standards. The evidence presented in this report is from one study of the effects of *STeLLA®* on students—including 59% White, 4% Black, 2% Asian, and 28% Hispanic students—in grades 4 and 5 in urban, suburban, and rural schools in Colorado.

What Happens When Students Participate in *STeLLA®*?

The evidence indicates that implementing *STeLLA®* has potentially positive effects on science achievement compared with another yearlong teacher professional development program.

Findings on *STeLLA®* from the one study that meets WWC standards are shown in Table 1. The table reports an effectiveness rating, an improvement index, and the number of studies and students that contributed to the findings. The effectiveness rating is based on the quality of the designs used in studies, whether the findings are favorable or unfavorable for the intervention, and the number of studies that tested the intervention. See Box 1 for more information on interpreting effectiveness ratings.

In order to help readers judge the practical importance of an intervention's effect, the WWC translates findings across studies into an "improvement index" by averaging findings that meet WWC standards within the same outcome domain. The improvement index can be interpreted as the expected change in percentile rank for an average comparison group student if that student had received the intervention. For example, an improvement index of +25 means that the expected percentile rank of the average comparison group student would increase by 25 points if the student received instruction from a teacher who had participated in *STeLLA®* instead of the professional development program provided to the comparison group teachers. A positive improvement index does not necessarily mean the estimated effect is statistically significant.

The evidence presented in this report is based on available research. Findings and conclusions could change as new research becomes available.

Table 1. Summary of findings on *STeLLA®* from one study that meets WWC standards

		Study Findings	Evidence meeting WWC standards (version 4.0)	
Outcome domain	Effectiveness rating	Improvement index (percentile points)	Number of studies	Number of students
Science achievement	Potentially positive effects	+25	1	2,823

Note: The effects of *STeLLA®* are not known for other outcomes within the Primary Science topic area, including life sciences, physical sciences, and earth/space sciences.

BOX 1. HOW THE WWC REVIEWS AND DESCRIBES EVIDENCE

The WWC evaluates evidence based on the quality and results of reviewed studies. The criteria the WWC uses for evaluating evidence are defined in the Procedures and Standards Handbooks and the Review Protocols. The studies summarized in this report were reviewed under WWC Standards (version 4.0) and the Primary Science topic area protocol (version 4.0).

To determine the effectiveness rating, the WWC considers what methods each study used, the direction of the effects, and the number of studies that tested the intervention. The higher the effectiveness rating, the more certain the WWC is about the reported results and about what will happen if the same intervention is implemented again. The following key explains the relationship between effectiveness ratings and the statements used in this report:

Effectiveness Rating	Rating interpretation	Description of the evidence
Positive (or negative) effects	The intervention is ***likely*** to change an outcome	Strong evidence of a positive (or negative) effect, with no overriding contrary evidence
Potentially positive (or negative) effects	The intervention ***may*** change an outcome	Evidence of a positive (or negative) effect with no overriding contrary evidence
No discernible effects	The intervention ***may result in little to no change*** in an outcome	No affirmative evidence of effects
Mixed effects	The intervention ***has inconsistent effects*** on an outcome	Evidence includes studies in at least two of these categories: studies with positive effects, studies with negative effects, or more studies with indeterminate effects than with positive or negative effects

How is *STeLLA*® Implemented?

The following section provides details of how districts and schools can implement *STeLLA*®. This information can help educators identify the requirements for implementing *STeLLA*® and determine whether implementing this intervention would be feasible in their districts or schools. Information on *STeLLA*® presented in this section comes from the study that meets WWC standards (Taylor et al., 2017) and from correspondence with the developer.

- **Goal:** *STeLLA*® aims to improve student science achievement by improving a teacher's ability to (a) explain science concepts to students, (b) clearly identify to students the science concepts used in student learning activities, and (c) engage students in thinking about science.
- **Target population:** *STeLLA*® is offered to teachers who provide science instruction to students in kindergarten to grade 12. Training is also available for school or district personnel who wish to become *STeLLA*® professional development leaders.
- **Method of delivery:** Teachers learn from postsecondary science faculty and *STeLLA*® professional development leaders at an in-person summer institute. During the institute, teachers begin improving their science content knowledge, become familiar with *STeLLA*® lesson plans and instructional strategies, and learn to analyze videos of experienced teachers delivering model lesson plans and using the instructional strategies. During the school year, teachers videorecord themselves delivering model *STeLLA*® lesson plans and meet in study groups at their school with in-person or online guidance from their *STeLLA*® professional development leader to analyze their own and one another's videorecorded lessons.

Comparison condition: In the one study that contributes to this intervention report, students in the comparison group received science instruction from teachers who participated in a yearlong professional development program designed to improve only their science content knowledge. These teachers did not receive *STeLLA*® materials or training and support from *STeLLA*® professional development leaders.

- **Frequency and duration of service:** *STeLLA*® is a yearlong professional development program for teachers that begins with a 2-week summer institute (60 hours) followed by eight monthly grade-level study group meetings during the school year (30 hours). Personnel who wish to become *STeLLA*® professional development leaders require an additional 1 to 2 years of training. Refer to Table 2 for additional details.
- **Intervention components:** The key components of *STeLLA*® are described in Table 2. Training for personnel to become *STeLLA*® professional development leaders, which can be bundled with the teacher program, is also described in Table 2 but was not part of the study that contributes to this intervention report.

Table 2. Components of *STeLLA*®

Key component	Description
Teacher professional development	During the yearlong *STeLLA*® professional development program, teachers (a) develop science content knowledge of two topics (for example, "the earth's changing surface" and "matter and molecules in the water cycle") that they will teach in their own classrooms in the upcoming school year, (b) review and implement *STeLLA*® model lesson plans, and (c) learn instructional strategies to support student learning. The professional development program begins with a 2-week (58 to 60 hours) summer institute facilitated by postsecondary science faculty and a *STeLLA*® professional development leader. Science faculty engage teachers in short lectures, readings, activities, and discussions of science concepts. *STeLLA*® professional development leaders lead teachers through a review of content-specific background documents that describe how science lesson activities, representations of science concepts, and analogies that are typically used in science instruction might support or interfere with student learning. *STeLLA*® professional development leaders also introduce teachers to the *STeLLA*® lesson plans, teaching strategies, and process for analyzing videorecorded lessons. During the school year, teachers meet with school-based study groups of other teachers of students in the same grade and their *STeLLA*® professional development leader monthly for eight discussion sessions each lasting 3 to 4 hours to continue learning how to convey science content to students and how to implement *STeLLA*® teaching strategies in their own classrooms.
STeLLA® lesson plans	At the summer institute, participating teachers receive *STeLLA*® model lesson plans for one of the two topics. The model lesson plans are detailed guides designed to build teachers' science content knowledge and familiarity with *STeLLA*® teaching strategies. They highlight common student responses to teacher questions and suggest ways for teachers to respond to students' ideas, predictions, and questions. Teachers review these lesson plans and analyze videos of experienced teachers delivering them. In the fall, teachers practice implementing the model lesson plans in their own classrooms.
STeLLA® teaching strategies	Teachers learn instructional strategies that emphasize: • Explaining science concepts, including using accurate descriptions, analogies, visual displays or models, and other representations of scientific content that minimize student misconceptions; allowing students to practice using these representations; describing the connections between science concepts; and summarizing key elements of these concepts. • Clearly identifying to students the science concepts used in student learning activities, including establishing a learning goal with a central question or objective, selecting activities matched to the objective, sequencing science content and learning activities appropriately, and identifying how the learning activities illustrate or draw on science concepts. • Engaging students in thinking about science, including asking questions to elicit and challenge student ideas and predictions; engaging students in interpreting data, summarizing science concepts, and applying those concepts to new contexts or phenomena; and encouraging students to communicate in scientific ways. Teachers first become familiar with *STeLLA*® strategies at the summer institute by watching videos of experienced teachers using them in science lessons. Teachers later practice using the strategies in planning and delivering science instruction in their own classrooms.
Analysis of videorecorded lessons in study groups	A *STeLLA*® professional development leader works with school-based study groups to analyze videorecorded examples of science instruction and accompanying examples of student written work. Teachers discuss their own and students' understanding of the science topics covered in the lessons and learn to identify *STeLLA*® instructional strategies that the videorecorded teacher used or could have used to support student learning. At the summer institute, teachers begin learning the lesson analysis process by discussing videorecorded lessons of experienced teachers implementing *STeLLA*® model lesson plans. During the school year, teachers videorecord themselves teaching the two science topics in their own classrooms and then analyze one another's videorecorded lessons and accompanying examples of student work. In the first half of the school year, teachers analyze videos of one another delivering *STeLLA*® model lesson plans. In the second half of the school year, teachers collaborate with their study group to develop their own science lesson plans for the second science topic by incorporating *STeLLA*® teaching strategies and anticipating student misconceptions. Teachers then deliver and videorecord these lessons and meet once more to analyze one another's instruction and summarize what they have learned over the yearlong program.
STeLLA® leadership development training	Also available is a 2- to 3-year program for school or district personnel to become *STeLLA*® professional development leaders. Participants complete 1 year of leadership training before they begin providing *STeLLA*® professional development to a cohort of teachers. During the second year of the program, the leaders-in-training receive support from the *STeLLA*® developer. This component was not part of the study that contributes to this intervention report.

What Does *STeLLA*® Cost?

This preliminary list of costs is not designed to be exhaustive; rather, it provides educators an overview of the major resources needed to implement *STeLLA*®. The program costs described in Table 3 are based on the information available as of May 2020.

Table 3. Cost ingredients for *STeLLA*®

Cost ingredients	Description	Source of funding
Personnel	Implementing *STeLLA*® costs approximately $1,750 per teacher for the yearlong program. Each participating teacher attends a 2-week summer institute and eight monthly study group sessions (up to 4 hours each) during the school year. A 2-year leadership development program for school or district personnel to become *STeLLA*® professional development leaders costs approximately $10,000 per leader, but this component is not required.	Schools and districts pay BSCS Science Learning for costs of providing the *STeLLA*® summer institutes and support for participating teachers (or leaders-in-training) throughout the following school year.

Cost ingredients	Description	Source of funding
	The 2-week summer institute typically takes place at a facility provided by the school district. School-year study group meetings take place at participating schools, with the professional development leader joining online or on-site depending on the availability of local *STeLLA*® professional development leaders and the agreement with BSCS Science Learning.	Schools and districts are responsible for providing the facility for the summer institute and the transportation to and from the facility. Schools and districts provide physical space for teacher professional development and classroom instruction during the school year.
	Teacher participants receive a set of grade-appropriate *STeLLA*® lesson plans for one of the two topics they will teach in the upcoming year, transcripts of program-developed videorecorded lessons and related examples of student work, a *STeLLA*® strategy guide, lesson analysis protocols, and other resources associated with *STeLLA*®. BSCS Science Learning provides teachers with online access to videorecordings made by members of their local study group. Participants training to become *STeLLA*® professional development leaders receive the same materials provided to teacher participants as well as videorecordings and transcripts from *STeLLA*® professional development sessions with teachers and additional resources specific to the leadership development program.	The fees that school or districts pay for teacher (or leader-in-training) professional development cover the cost of program materials provided to participants. Schools and districts are responsible for the costs of videorecording participating teachers.

For More Information:

About *STeLLA*®

BSCS Science Learning, 5415 Mark Dabling Boulevard, Colorado Springs, CO 80918
Attn: Jody Bintz, Associate Director for Strategic Partnerships & Professional Learning
Email: jbintz@bscs.org Web: https://bscs.org/our-work/rd-programs/stella-science-teachers-learning-from-lesson-analysis/.
Phone: (719)-513-5550

About the cost of the intervention

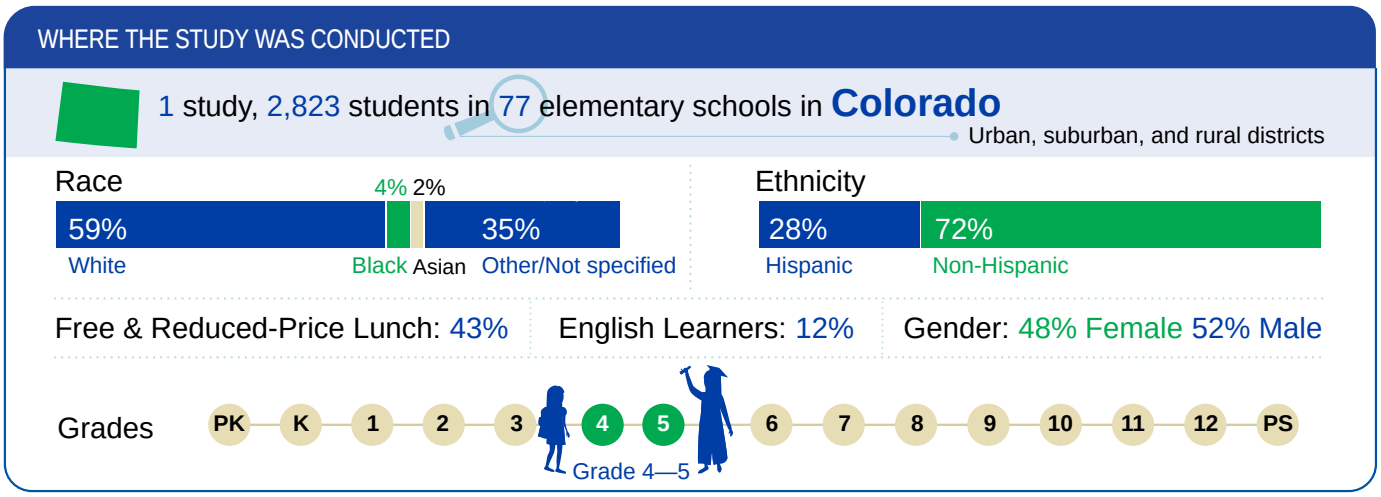
Actual program costs available in consultation with the developer.

About the study that meets WWC standards

Taylor, J., Roth, K., Wilson, C., Stuhlsatz, M., & Tipton, E. (2017). The effect of an analysis-of-practice, videocase-based, teacher professional development program on elementary students' science achievement. *Journal of Research on Educational Effectiveness, 10*(2), 241–271. https://eric.ed.gov/?id=EJ1135795

In What Context Was *STeLLA*® Studied?

The following section provides information on the setting of the one study of *STeLLA*® that meets WWC standards, and a description of the participants in the research. This information can help educators understand the context in which the study of *STeLLA*® was conducted and determine whether the program might be suitable for their setting.a



LEARN MORE

Read more about the *STeLLA*® intervention and the study that is summarized in this brief in the Intervention Report.