Contents

A. Significance

A.1. National Significance of Outcomes

Children comprise 23% of the US population, but 32% of children (over 14 million) live in poverty (Koball & Jiang, 2018). Parent education is the strongest predictor of employment, income level, and child academic success (Koball & Jiang, 2018; Tang, Davis-Kean, Chen, & Sexton, 2014). Therefore, to break the cycle of poverty in our nation, we must improve academic outcomes for all children. One of the most foundational skills in education is **reading and comprehending expository texts** (Gersten, Fuchs, Williams, & Baker, 2001; Guthrie & Davis, 2003). Expository text reading comprehension is critical for academic success in school (National Educational Goals Panel, 1999). Understanding and remembering information from expository text is also important throughout the life span to further develop intellectual abilities (Ackerman, 1998).

Expository texts have a different (and often more complex, less intuitive) structure than narrative, and so comprehension strategies for such texts need to be taught explicitly (see Edmonds et al., 2009, Gajira, Jitendra, Sood, & Sacks, 2007; Gersten, Fuchs, Williams, & Baker, 2001). Current learning standards dictate that students in upper elementary and beyond be able to read and comprehend challenging expository texts required to teach science and other academic subjects. The language of science, in particular, can be complicated and abstract. There is extensive vocabulary not frequently used in everyday language, and often the sentence structures are necessarily complex, as more simple structures may not accurately communicate the complexity of the information (Shanahan, Fisher, & Frey, 2016). This requires students to learn a different language; they must learn to “talk science” (Lemke, 1990). "Talking science" means observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, theorizing, questioning, challenging, arguing, designing experiments, following procedures, judging, evaluating, deciding, concluding, generalizing, reporting, writing, lecturing, and teaching in and through the **language of science**. **As society becomes more technologically advanced, understanding expository science text and computational thinking becomes increasingly important (Wijekumar, 2017[1]).**

Unfortunately for many students who attend schools serving large numbers of **Spanish speaking English learners**, schools in **high poverty areas**, and on **American Indian reservations**, mastering skills for effective reading comprehension in science is an elusive goal (King-Dickman, 2013; Marshall, 2013). National and State assessments of reading comprehension in our schools show a dismal picture with:

- Science test scores show poor outcomes for all learners and are consistently lower for children in lower SES and American Indian schools and Spanish speaking Els (NAEP, 2015).
- Around 32% of fourth graders reading below basic levels of proficiency (NAEP, 2015).
- More than 50% of students enrolled in New Mexico Bureau of Indian Education (BIE) schools require learning assistance (compared to approximately 13% nationwide; NCES, 2015). This means that more than half of students in BIE schools are struggling to learn English and participate successfully in regular course work.
- Additionally, 74% of the fourth-grade students scoring at the lowest 25th percentile (score lower than 200 on the NAEP) were eligible to receive a free/reduced price school lunch.
- “Two-thirds of students who cannot read proficiently by the end of the 4th grade will end up in jail or on welfare” (p. 27) Marshall (2013).

[1] **Wijekumar, K**. (2017). Pragmatic Scaffolding for Computational Thinking Using Text Structures: Theoretical and Empirical Lenses on K-12 Classrooms, 8th Annual International Conference on Computer Science Education: Innovation & Technology

- Schools serving high need communities are rife with problems of teacher knowledge and turnover and may cause poor learning outcome for learners (Bryk & Snyder, 2002).

Our Proposed Powerful Solution to These Systemic Problems

There are two components, or active ingredients, in this intervention: MOOV and ITSS. Massively Open Online Virtual (MOOV) Learning Environment is used to provide strong, effective practice-based professional development to teachers in an on-going basis. Intelligent Tutoring for the Structure Strategy (ITSS) is a cloud-based computer program used to teach text strategy structure (TSS). Evidence for these approaches are provided below.

"*Only one piece of software that taught reading, Intelligent Tutoring for the Structure Strategy (ITSS), showed promise, suggesting that it is possible to create good educational software outside of math, but it's a lot harder."* US News and World Report, 2017[2]

Through multiple grants from the US Department of Education, Institute of Education Sciences awarded to PI Wijekumar and colleagues, to develop and research the efficacy of the ITSS program (available in English and Spanish), more than 800 teachers have received professional development to improve science and other content area reading comprehension of over 20,000 students in grades 3 and above with both monolingual English speakers and Spanish speaking English learners. Evidence of the power of the method and ITSS continues to grow (Wijekumar, Meyer, & Lei, 2012; Wijekumar et al., 2014; Wijekumar, Meyer, & Lei, 2017).

[2] https://www.usnews.com/news/education-news/articles/2017-09-25/3-lessons-learned-from-education-technology-research

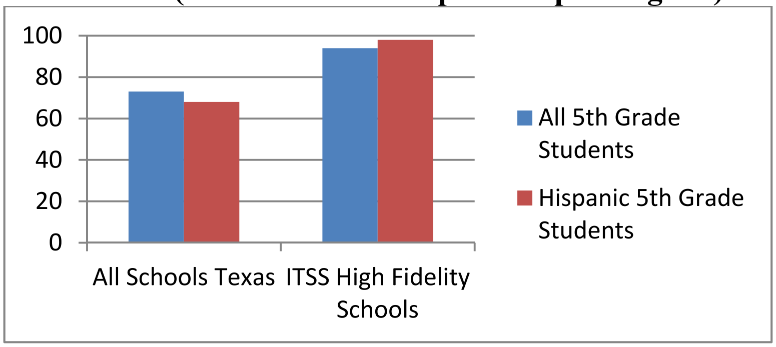
ITSS has STRONG Evidence with support from the ***What Works Clearinghouse review of the 4th-grade report with a*** *rating of -* ***meets evidence standards without reservations***[3]

Hallmarks of the ITSS program worthy of SEED funding include:

- The *text structure strategy* (TSS) presented in this training provides a powerful *causal chain foundation for computational thinking and science learning*.
- Text structures have been identified by the National Reading Panel as an important approach to comprehension.
- Strong results in large scale cluster randomized studies with children in grades 4, 5, 7, and 8. Results with Spanish speaking Els has been even stronger.
- Over 60 science lessons with causal inference chaining in English and Spanish.
- Special software assistance for vocabulary, sentence, contextual, and passage level assistance for Spanish speaking Els to scaffold understanding of scientific texts
- Special assistance for struggling readers with fluency and vocabulary support.
- Powerful results in the most recent US DOE-IES funded efficacy grant to bring the TSS to teachers and students in high poverty schools with over 90% Spanish speaking English learners showed **20+ point improvements in the Texas STAAR test scores for children in all subject areas: science** (shown in Figure A1), math, reading, and writing.
- Strong practice-based professional development for teachers through powerful face-to-face and web-based instruction and practice.

[3] https://ies.ed.gov/ncee/wwc/study/77453

Figure A1 – Percentage of ITSS High Fidelity School Students Passing 5th Grade Texas STAAR Science Test vs. State (All Students and Spanish Speaking Els)



Rigorous research that has been reviewed by the What Works Clearinghouse (WWC) confirms the efficacy of the ITSS software with teacher professional development at elementary and middle grade levels with **STRONG Evidence** for students at grades 4 and 5 (Wijekumar, Meyer, & Lei, 2012; Wijekumar et al., 2014). ***The WWC has reviewed the 4th-grade report and has rated it as meets evidence standards without reservations***. This MOOV proposal overlaps with these findings on grade levels (i.e., 4 and 5) and also on the domains of **Competitive Priority – STEM**. In the reported efficacy studies, ITSS was used to present instruction to students in grades 4, 5, 7, and 8, contains over 95 lessons in diverse content areas (including 60 in science), is customizable to contexts (e.g., students with dyslexia), and contains strong teacher professional development using MOOV practice-based professional development (PBPD) and a practitioner community of practice.

Massively Open Online Virtual (MOOV) Learning Environment at Texas A&M University in collaboration many school districts, New Mexico State University, and the International Dyslexia Association addresses:

Absolute Priority 1: Supporting Effective Teachers
Competitive Preference Priority (CPP): Promoting STEM Learning
Invitational Priority: Support for the Use of Micro-Credentials

A.2. Potential contributions to Teacher Development - Skills Theory, Knowledge, and Practice

With the support of a SEED grant, the team plans to increase the number of trained teachers by 2800 and capture, analyze, and disseminate data and tools about the professional development, teacher up-take of approach (as well as barriers to effective implementation), and student learning outcomes resulting from the changes. A cluster randomized controlled trial with over 56 schools (site-based random assignment of schools to MOOV or control) and developing a MOOV based network of practitioners (over 2800), we hope to extend the development of theory, knowledge about teaching science reading comprehension in the ever changing landscape of schools, create a feedback loop allowing continuous differentiation and improvements to the MOOV PD and ITSS student lessons, and impact over 2800 teachers and 70,000 students in high-need schools. The measurement and data collection will be conducted by the Education Research Center at Texas A&M University with external quality assurance and checks conducted by Analytica Inc. Combining the impartiality of this study implementation with a *research design that meets the What Works Clearinghouse Evidence Standards without reservation will increase the likelihood of producing actionable findings to make effective positive change in high-need schools.*

Through the comprehensive MOOV teacher PBPD and rigorous evaluation we advance theory, knowledge, and practice by:

- Identifying practices that are impactful in improving teacher up-take of evidence-based instructional practices surrounding science reading comprehension. In coordination with these practices will be valid and reliable measures that can be used for high-fidelity implementation of the MOOV ITSS.
- Generating and adapting strong instructional materials for promoting sustainable changes in

teacher practice. Examples of these materials and guides will be integration of the TSS to local school level textbooks and teacher preferences.

- Supporting sustainable change through web-based and locally coordinated community of practice. The MOOV platform allows the team to reach wide geographic regions with high quality PD and support for contextualization to local needs.
- Developing and refining theoretical models of teacher professional development within difference contexts (e.g., high poverty environments with high teacher turnover; effectiveness of online, in-person, and hybrid approaches).
- Capturing and disseminating successful teacher PBPD implementation approaches at the state and national levels for both public and charter schools.

Issues in high-need schools	**How the need is addressed through MOOV+ITSS**
Low reading comprehension (NAEP, 2017)	• Improved teacher knowledge of science reading comprehension strategies such as the TSS
Low science performance (NAEP, 2015)	• Improved teacher knowledge of science reading comprehension strategies e.g., causal reasoning impacting student performance
Higher turnover (Ingersoll, 2001) due dissatisfaction with job (e.g. discipline problems, student motivation, lack of administrative support)	• Improved pedagogical knowledge that helps in improving student motivation and decreasing discipline-related issues • Administration and lead teacher trainings on TSS to increase support teachers during implementation • Readily available on-line resources (e.g, materials, videos) for continuous improvement and brush up
Underprepared Teachers	• Improved teacher knowledge of and instructional pedagogy for reading comprehension • Tailored assistance for each school focused on local areas of need • Online access to research-based materials with strong evidence (e.ge. lesson plans, ITSS)
Lack of long-term support for teacher PD	• Continuous support for implementation (in-person, online, & peer group) • Micro credentials • Long-term advanced degree encouragement

The team has the potential to successfully complete this SEED grant project by utilizing powerful tools within the MOOV platform (created using the PBPD approach for all grade level teachers (i.e., science, mathematics, special education, language arts):

- Teacher modeling videos (10 to 20 minute segments showcasing master teachers)

- Synchronous discussions (webinars and live chat with experts)
- Asynchronous presentations (pre-recorded videos and discussion forums).
- Interactive web-based ITSS lessons for teachers and school literacy leaders.
- Participation through mobile devices, chat bots, and a knowledge forum designed to provide intermediate assistance based on user queries to an intelligent knowledge base.
- Push notifications on cell phones to registered users when new lessons are available.
- Allows teachers to learn, practice, record, reflect, and revise their instructional practices during the initial courses during the summer months.
- Extends support to teachers using SWIVL (hands free webcam which follows the teacher to capture or stream high quality audio and video)
- Planning and customization tools for teacher lessons for the upcoming year using the lesson planning tools, sample lessons (e.g., states of matter, human body systems)
- Teachers will receive training on how to customize themselves as well as see examples of customization prepared by the MOOV team with special education expertise
- Extend and customize lessons (e.g., selecting additional lessons for students diagnosed with a learning disability) within the ITSS web-based lessons in English and Spanish.
- Large repository of vertically and horizontally aligned lessons that are available in many different content areas (e.g., science, language arts) and address student needs through varying text readabilities. Teachers may also select their own texts to add to the repository with assistance from the MOOV team.
- Repository of foundational lesson components (e.g., TSS activities) aligned with many popular curricula adopted by schools (e.g., Journeys, MacMillen)

- Lessons with on-demand assistance in Spanish or vocabulary assistance if needed to better support Spanish speaking English learner (Wijekumar et al., 2017[4]).

During the school year, the MOOV collaborative extends services to teachers as a community of practice (Lave & Wegner, 1991) to share their experiences, receive feedback, problem-solve, request and receive information, request and receive in-school coaching or co-teaching (either virtually using SWIVL web-cam technologies or face-to-face), discuss developments and challenges, share and reuse assets, identify needs, and continues to build a repository of knowledge for further extending the supports to teachers. Through this community of practice we crowd source teacher intellectual capacity and will be able to share and exchange successful implementations as well as seek advice from others in the trenches and MOOV facilitators on how to improve implementation.

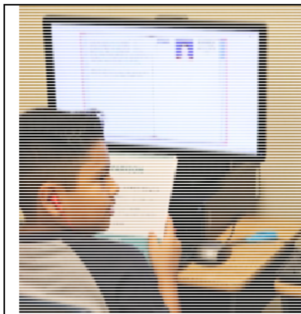
Teachers will be supported for on-going practice, reflection, and revising of their teaching strategies and will earn badges, certificates, and/or be encouraged to become life-long learners through advanced degrees.

A.3: Magnitude of Impact on Student Achievement in High Need Schools

As noted by the What Works Clearinghouse and US News and World Report article (2017), ITSS has strong evidence in improving content area reading comprehension, including science comprehension. **The most recent implementation of ITSS in high poverty schools** that serve over 90% Spanish speaking Els shows **powerful results with over 94% of children passing all subject areas and 100% of special education students in grades 4 and 5 passing their science and language arts tests (See Figure A1).** We anticipate continuing this

[4] **Wijekumar, K.**, Meyer, B.J.F., Lei, P-W, Hernandez, A., August, D. (in press). Effects of web-based text structure instruction for 4-6th grade Spanish Els reading comprehension. Reading and Writing: An Interdisciplinary Journal

progression by expanding our impact to more high need schools with powerful results for children who would otherwise not have the opportunities to succeed.

	Principal Garza: *Astronomical Increase in Student Performance with Text Structures.!!* http://transform.tamu.edu/news/text-structures-success-improving-test-scores-brownsville	**Text Structures For Success: Improving Test Scores In Brownsville** 

Through the MOOV ITSS (English and Spanish) toolset we will improve the likelihood that over 70,000 children in high-need schools will receive high quality instruction in science reading comprehension by *increasing the number of skilled teachers by 2800 and supporting the teachers and students with consistent, high quality, and evidence based instructional materials*. Schools and teachers provide one of the most powerful opportunities to help these children, because these students begin school with little to no support for science reading from their families (Bradley, Corwyn, McAdoo, & Coll, 2001; Chin & Phillips, 2004). The MOOV ITSS repository will be a continuously expanding resource for teachers and students with materials updated for local contexts and adaptive lessons for learners from a myriad of backgrounds and prior knowledge. Figure A2 outlines how the text structure strategy presented in the web-based ITSS supports the improvement of science reading comprehension.

Table A1: Professional Development Sequence

PD – Day 1 8 hrs	**Topics & Skills: ITSS Background and foundational skills, modeling, practice** **Earn:** CEUs and certificates **Access:** face-to-face, synchronous webinar, or asynchronous video
	1. Learn about text structures – comparison, problem and solution, cause and effect, sequence, and description 2. Learn about text structure strategy (TSS) 3. Apply learning by reviewing a real TSS lesson (Topic: biomes, text structuresL

	cause and effect and comparison) • Identify signaling words for comparison and cause and effect • Write a GIST/Main Idea about Topic • Generate inferences (e.g., why do fewer people live in desert biomes?) • Create causal inference chain on population densities in different biomes • Generate computational thinking algorithm to predict population changes in biomes 4. View a model teaching video of a teacher implementing the biomes lesson (available in MOOV ITSS lesson library) 5. Review and reflect on all lesson components including lesson foundations required to build background knowledge • Activate background knowledge (selecting a picture or video about topic) • Identify and teach key vocabulary (struggling readers & Els) • Identify and teach phonemes (students with reading disabilities) 6. Practice delivering the biomes lesson (practice lessons are video recorded, used for reflection, are shared, and available for future reference for teacher) 7. Teacher plans a different lesson by selecting materials from MOOV lesson library and preparing all foundational lesson activities
PD Day 2 4 hrs	**Topics & Skills: Teacher as student, reflection, revise and post lesson** **Earn:** badges **Access:** face-to-face, synchronous webinar, or asynchronous video
PD Day 2 2-4 hrs	1. Teacher completes all activities in a web-based ITSS biomes lesson as if s/he is a student. 2. Teacher reflects on the experience from a student point of view 3. Teacher updates the lesson s/he previously created incorporating reflections 4. Teacher posts updated lesson plan to the MOOV ITSS lesson library
PD day 3 in-sch.	**Topics & Skills:** Local context planning and implementation **Earn:** Crowd-sourced badges, certificates, course credits **Access:** face-to-face, synchronous webinar, SWIVL, or asynchronous video **Time:** on-going, during PD and across the school year
2 hrs	1. Teachers choose a lesson from a textbook or a learning standard s/he wants to address 2. Identify resources from MOOV ITSS lesson library to align with school curricula (e.g., light; the library currently contains lessons aligning with Journeys, Discovery, Scott-Foresman, & Macmillan) 3. Reflect on current student needs and identify what foundational lesson components need to be included a. Activate background knowledge (e.g., a video about light) b. Teach key vocabulary for struggling readers and Els (e.g., refraction) c. Teach phonemes or other skills to students with reading disabilities 4. Review, practice deliver, and reflect on actual text structure based lesson and delivery using comparison and cause and effect, situating the lesson in the local context a. Identify signaling words for comparison and cause and effect b. Write a GIST/Main Idea about Topic c. Generate inferences (e.g., why does mirror reflect light?)

	d. Create causal inference chain on how light interacts with different surfaces e. Generate computational thinking algorithm to predict light path 5. Post contextualized lesson and reflection to MOOV ITSS 6. Teach the lesson to students 7. Receive support from MOOV via SWIVL webcam within classroom or f-2-f coaching by science, literacy, SPED Coaches

Figure A2. How MOOV+ITSS Impacts Teachers and Student Science Learning Outcomes

Wijekumar et al., (2018) [5]showed that student reading comprehension outcomes can be greatly strengthened when teachers are knowledgeable about text structures and can promote the application of text structures in the classroom. The example presented in the video[5] shows that 4th and 5th grade teachers receiving 2 days of professional development, 6 days of in-school coaching and modeling, strong administrative support, and access to resources designed to provide consistent instruction across all content areas **resulted in six-star distinctions for the school**. This meant that the school had hovered around the same scores in all subject areas for over 5 years and went above 94% pass rates in all subjects after using the ITSS and teacher PBPD. **Most notable were the improvements in the special education students who had a 100% pass rates in science after the instruction**.

Benefits of MOOV tools		
Improvement over typical video PD	**Increased team time and resources for support**	**Increased school resources**
• Gather teacher knowledge about the text structure and instructional practices • Provide live assistance and support to the teachers (virtually & in person) • Engage teachers in ways typical video alone cannot do	• On-going support during the academic year • Virtual and face-to-face coaching • Modeling in classrooms for students • Persistent access to PD materials, example videos, and lesson materials	• Access to knowledge database constructed through MOOV virtual community of practice • Local context • Motivation • No cost for schools • Crowd sourcing teacher intellectual capacity

[5] http://transform.tamu.edu/news/text-structures-success-improving-test-scores-brownsville

A.4. Reasonableness of Costs

The MOOV model is unique in leveraging the best of technologies in support of building teacher and support personnel capacity and human intellectual capital at the school level. Within this MOOV project we will begin with school level administrators and a school leader who will serve as the liaison to the project. Teachers will complete approximately 3 days of PBPD on the MOOV and be supported by school leaders who will receive an additional 2 days of MOOV and face-to-face instruction. As noted earlier, all the instruction for the text structure-based science reading comprehension is available via asynchronous videos and discussion forums. Content for synchronous webinars are also available either live or in recorded format. Finally, teachers can practice their own text structure skills using the advanced lessons on the web-based ITSS tutor receiving modeling, practice tasks, assessment, and immediate feedback from the Intelligent Tutor (I.T.). This is an extension built using the ITSS authoring tool originally developed to build student lessons.

Finally, the MOOV platform provides teachers with continuous updates to lessons and classroom resources and makes them easily accessible through mobile devices (e.g., push notifications on cell phones to registered users when new lessons are available) and is reachable on-demand at any time. Providing high quality materials that are relevant to the local context can potentially increase the motivation of the teachers and learners and increase the utility value of the lessons to both groups. Student voice is an important part of the MOOV and ITSS platforms where students can report on their interest in the topics as well as make suggestions for science reading topics. Teacher usage data through the MOOV platform provides a significantly cost-effective way to monitor implementation so that the MOOV team can reach out to teachers when needed.

A.5. Sustainability of MOOV project

By structuring the PBPD around the MOOV platform with easily accessible tools (e.g., mobile device access) and promoting the development of an instructional community of practice centered on science reading comprehension, we anticipate that teachers will receive the instruction they need to become better teachers and continuously improve their practices. This model can be applied to new teachers as well as veteran teachers who want to improve their instructional skills. By providing services to all teachers at the grade level, this MOOV approach is designed to increase the capacity of *all teachers to become proficient in science reading comprehension and computational thinking*.

The MOOV platform development was initially funded through a grant from Texas A&M University and the Center for Urban School Partnerships (CUSP) lead by PI Wijekumar. The CUSP will lead efforts to promote the MOOV beyond this grant and create a sustainable project. The future plans may include a minimal membership fee for schools to enroll in this cooperative and seek additional funds from private and public sources to offset maintenance and updates.

A.5. Dissemination of Results from MOOV Project

The CUSP at Texas A&M University led by PI Wijekumar, in collaboration with New Mexico State University and a team of affiliated faculty, has developed a long-term strategy to engage school leaders and practitioners through online tools such as the MOOV, conducts regular School Impact Summits (i.e., dissemination conferences) in collaborating states, regular webinars, and maintains a web-site with regular updates on evidence-based practices. CUSP works closely with large entities such as the International Dyslexia Association and European Literacy Network to disseminate findings from research studies. We hope to continue those activities and increase the capacity of CUSP to disseminate the findings from this project.

B. Quality of Project Design

This MOOV project represents an exceptional approach to address the SEED priorities related to teacher quality and science reading comprehension at the upper elementary grades. With this design shown in Table A1 we present evidence that the MOOV services to be provided will be of sufficient quality, intensity, and duration to lead to improvements in practice among the 2800 recipients of those services. The team is composed of personnel with extensive experiences with collaboration of appropriate partners (e.g., experts in science, reading, literacy, special education) for maximizing the effectiveness of project services. This MOOV proposal focuses on three strategic goals presented in Table B1 with the objectives and measurable outcomes.

Table B1: Strategic Goals and Objectives

Goal 1 – Support the development of 2800 highly effective elementary school teachers with the capacity to deliver strong science reading comprehension and computational thinking instruction to over 70,000 students			
Objective	**Measurable Outcomes**	**Target**	**National Impact**
Recruit and provide PD to elementary school teachers	Number of teachers recruited and trained	2800 teachers in high need schools	Increased teacher capacity to deliver powerful evidence-based science comprehension and computational thinking lessons to students
Ensure teacher participation in PD,	Percentage of teachers attending synchronous and asynchronous sessions (4 days) Percentage of teachers completing ITSS teacher lessons Percentage of teacher customizing ITSS lessons	90% attending 3 of 4 days 90% completing ITSS teacher lessons 50% customizing lessons for their own classrooms	
Improve teacher retention and promote reflection for sustainability	Percentage of teachers retained within school	Reduce teacher attrition at participating schools to 20%	Increased teacher retention contributing to stability for students
Promote and improve	Classroom observation	70% of teachers using	Increase teacher

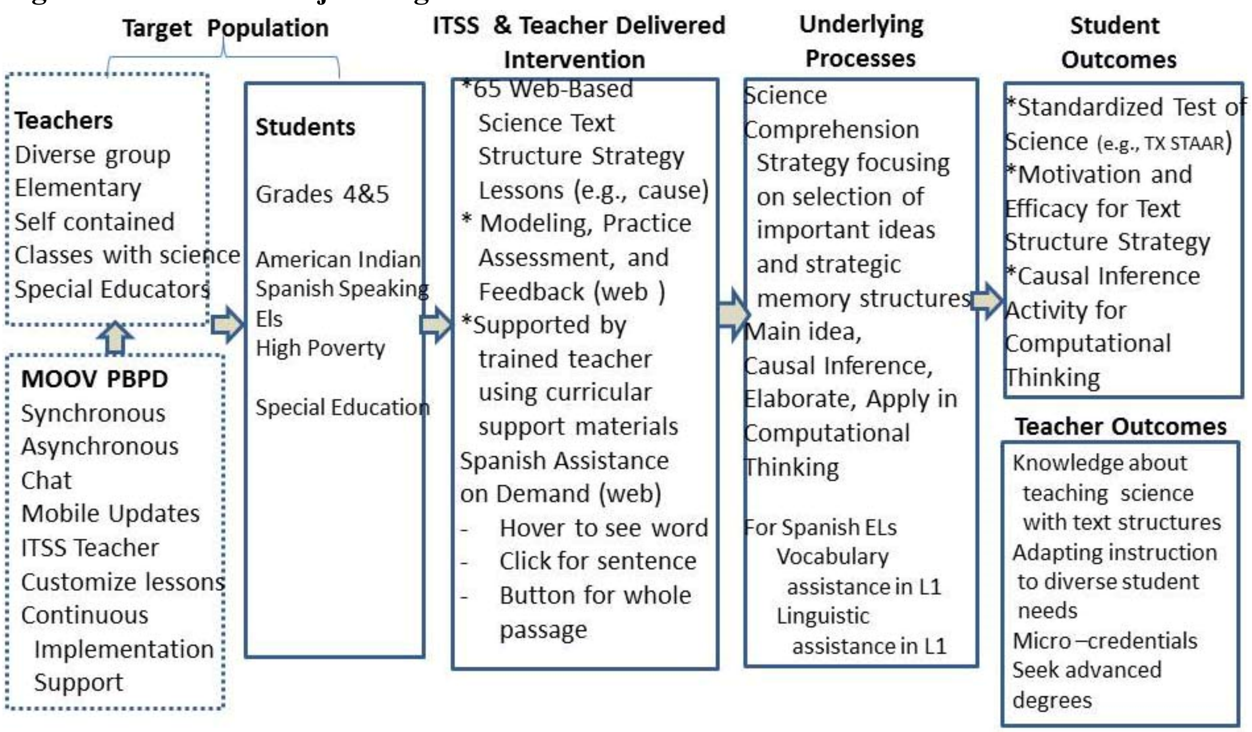
high-quality teacher-led instruction about using evidence-based text structure instruction to improve comprehension of science texts, critical, and computational thinking.	through SWIVL web conferencing. Document percentage of time spent on text structure instruction within science classroom	the text structure strategy and ITSS lessons	capacity and efficacy to deliver high quality evidence-based text structure instruction in science
Goal 2 – Strongly Impact high need fourth and fifth grade students' science reading comprehension and computational thinking outcomes			
Serve students from high need schools	Percentage of high need students in each participating school	Schools serving over 50% Spanish speaking English learners, over 50% eligible for free or reduced-price lunch, and American Indian Reservations	Improving the likelihood that students in high need schools (e.g., Spanish speaking Els, SPED) receive outstanding science instruction
Increase student achievement in standardized and researcher designed measures of science and computational thinking	Percentage of students passing the state science tests Percentage of students able to create their own causal inference science lesson in ITSS	75% science 80% causal inference ITSS lesson	Make a lasting difference for the professional and personal life trajectories of children
Goal 3 – Create a sustainable community of practice to continuously improve teaching practices with supports for teacher implementation and credentials			
Create local community of practice and weekly engagement meetings and connect school community with MOOV community of practice.	Number of communications made via MOOV	75% of schools report weekly engagement meetings 75% of teachers continue to post in MOOV a minimum of once a month	Sustainable implementation of the MOOV ITSS that is a model for national rollout
Link participating teachers and school leaders to MOOV micro-credentials	Number of teachers earning micro-credentials	60% of teachers enrolled or earning micro-credentials	Crowd sourcing the intellectual credentials promoting lasting impact

Support teachers to continuously grow and learn through further certifications and degrees related to science literacy and computer applications	Number of teachers earning further certifications and/or degrees related to science literacy and computer applications	30% of teachers enrolled in or earning certification/degree	Encourage 2800+ teachers to become lifelong learners & serve high need school children

B.1. Strong Approach to Priorities

The focus of the MOOV project is on all elementary school teachers (Total of 2800 in 56 schools) who are at the front line of improving science reading comprehension at the critical elementary grades within schools located in American Indian Reservations and those serving high numbers of Spanish speaking English learners, and high poverty residents. The MOOV project represents an exceptional approach utilizing sophisticated virtual tools and human capital to address absolute priority 1 (Effective Teachers), competitive priority on STEM, and the invitational priority established for this 2018 SEED competition. Our logic model for the MOOV project is presented in Figure B1.

Figure B1: MOOV Project Logic Model



B.2. MOOV and Continuous Implementation Support is of Sufficient Quality, Intensity, and Duration Potentially Leading to Improvement

The MOOV PBPD activities shown in Tables A1 and B2 will be of sufficient quality, intensity, and duration to lead to improvements in practice among the fourth and fifth grade teachers and school leaders from schools located on American Indian reservations, serving Spanish speaking English learners, and high poverty neighborhoods. MOOV teacher PBPD will last approximately 5 days, additional 1 day of PBPD will be delivered to school leaders, and an additional 2 to 4 days of in-school coaching and/or co-teaching with access to MOOV and ITSS customization tools will be available during the implementation years. Discussion forums on MOOV will be available for each lesson/activity In the MOOV and will remain open throughout the implementation.

Table B2: Highlights MOOV lesson plans for science reading comprehension

MOOV Lesson/Activity/Lead	Activity	Days of PD	MOOV Component
Introduction to science reading comprehension *Wijekumar, Olson, Joshi, Cromley*	Understand the stages of reading, prerequisite skills (e.g., decoding, vocabulary), and science reading comprehension strategies	Day 1	Video Webinar Synchronous Face-to-face
Role of text structures (comparison, problem & solution, cause & effect, sequence, description) in science reading comprehension *Wijekumar, Meyer, McKeown*	Using the text structure strategy to: Identify signaling/linking words Write a main idea/summary Monitor comprehension Generate causal inferences Generate computational thinking maps using cause/effect and problem/solution	Day 1	Video & ITSS web-based teacher lessons with modeling, practice, assessment, feedback
Practicing as a student	Interact with ITSS lessons designed for teachers with Animated Pedagogical Agent I.T. modeling text structure use, practice tasks, immediate feedback and support	Day 2	ITSS teacher lessons (see above)
Reviewing available science content for grades 4 and 5 Develop student	Watch teacher modeling videos Review lessons in content areas (e.g., science – biomes) Review pre-lessons for children with	Day 2	Asynchronous video, webinar, f-2-f and discussion

computational thinking lessons on the ITSS framework Science - *Wijekumar, Olson, Cromley, Joshi, Meyer* SPED – *McKeown, Thompson, Cardenas-Hagan, McCardle* Spanish – *Hernandez, Cardenas-Hagan*	diagnosed disabilities Review lesson adaptations for Spanish speaking English learners		
Reviewing school level needs and classroom context Science - *Wijekumar, Olson, Cromley, Joshi, Meyer* SPED – *McKeown, Thompson, Cardenas-Hagan* Spanish – *Hernandez, Cardenas-Hagan*	Conducted individually for each school	Days 3-4	Synchronous SWIVL and/or webinar
	Extended support and work with school leaders. Customize lessons for local textbooks (e.g., Journeys) and teacher preferred resources (e.g., science labs)	Days 3-4	Webinar, Chat, SWIVL face-to-face(if needed)
	Teacher creates their own teaching video for reflection and changing practice	Days 3-4	MOOV submission with reflection
Sustain teachers throughout implementation	MOOV courses, videos, classroom materials, and access to team experts will be open to teachers and school leaders throughout the implementation years.	Days 4-6 as needed	Micro and macro credentials and community of practice

Data will be gathered continuously throughout the MOOV implementation based on teacher and administrator login (proxy for attendance), number of interactions within ITSS (all lesson activities completed and questions answered will be used to monitor participation as well as teacher knowledge about text structures. We will also be collecting videos from intervention group teachers for coding, reflection, feedback, and formative evaluation of project.

B.3. MOOV Utilizes Strong Partnerships

This MOOV project brings together an excellent collaborative team from Texas A&M University (Center for Urban School Partnerships and Education Research Center ERC), New Mexico State University, and The International Dyslexia Association for maximizing the effectiveness of project services. Both TAMU and NMSU have teamed on numerous research projects and their expertise in working in high-need schools has been documented in three recently completed and one on-going efficacy project funded by the US Department of Education IES. The Center for Urban School Partnerships and Education Research Center are uniquely suited to manage the MOOV platform and the measurements. Analytica, Inc., has a long track record of supporting large scale randomized controlled trials with Regional Educational Laboratories of the US Department of Education and extensive expertise in What Works Clearinghouse Standards.

The school partners on this project meet the SEED criteria for high-need schools and are dedicated to improving science reading comprehension at upper elementary grades. The schools are enthusiastic to receive the MOOV PD and support for their teachers and school instructional leaders. Letters of support have been provided by Brownsville Independent School District and Navasota Independent School Districts in Texas, Las Cruces Public Schools, and Bernalillo School District (New Mexico serving American Indian children).

This project is also supported by an outstanding team of experts with many years of experience in development, research, and dissemination expertise in science. Drs. Cromley, Meyer, Lei, McCardle, and Cardenas-Hagan are committed to supporting this project.

B.4. MOOV Focuses on Greatest Needs

There is no greater need for every child than to receive an outstanding education that leads to a brighter future. Education is the way out of poverty and success in the 21st century. Reading comprehension in STEM disciplines is the vehicle to deliver the biggest impact on this journey. Teachers are the catalysts to this process especially for students coming from complex settings where they receive little to no support prior to entering school, after school, and during their critical developmental years. This MOOV project is designed to make an impact on the students through highly trained and credentialed teachers, and administrators within high-need schools.

B.5. MOOV Design Addresses Particular Needs of High-Need School Teachers and Students to Make an Impact on Disadvantaged Students

High-need schools are in desperate need of interventions that can improve science reading comprehension of students as evidenced by the national assessments (NAEP, 2011) and research reports (Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2007; Bryk & Schneider, 2002; Hart & Risley, 1999; King-Dickman, 2013; Marshall, 2013). **Students in high-need schools are more likely to have lower achievement scores, higher chances of dropping out, higher chances of being incarcerated**, etc. Because science reading comprehension is an important skill for most academic and non-academic activities, it is important to provide these children with the basic skill of science reading comprehension to improve their chances of success in school and beyond. As noted earlier, these challenges are caused by a myriad of reasons including environmental and social issues, poor schools, and teacher issues such as inexperience and high turnover.

Carter (2000) listed, **teacher quality**, effective diagnostic testing, **emphasis on basic skills**, and allocation of funds as effective practices that have made high-need schools successful. This **proposal addresses two of these target areas: teacher quality and science reading comprehension skills**. Solutions to problems in high-need schools have focused on teachers' skills in delivering reading comprehension instruction, teacher team building, and teachers' impact on reading comprehension and classroom learning. Parrett and Budge (2012) have noted that teacher PD and capacity building are important elements of improving learning for the children in high-need schools. Croninger (2012, p. 1) states, “Students in majority-poverty classes are more dependent on their teachers to mediate the curriculum and provide multiple representations of mathematics.” Cunningham (2006) reported on factors of reading instruction that work in high poverty schools (i.e., instruction, time reading & writing, perseverance & persistence implementing a strong instructional framework, and student engagement).

Based on these solutions that have worked in high poverty schools, we see the value of teachers routinely applying the structure strategy taught in ITSS to reading classroom texts relevant to their particular students and science curricula. Additionally, ITSS provides a good match with Cunningham’s concept of a strong instructional framework, student engagement, and perseverance and persistence particularly in high-need schools. The MOOV PBPD related to teacher quality is designed to assist teachers in effectively and regularly applying the structure strategy with science texts relevant to their students and curriculum needs.

Basic skill in science reading comprehension is the second area targeted by this proposal. Denton, Foorman, and Mathes (2003) compiled strategies used in high poverty schools that “beat the odds.” These strategies included systematic approach to science reading comprehension, relentless intervention, accountability, assessments, and matching student needs with instruction. These five approaches will be used in this proposed project. ITSS provides a systematic approach to science reading comprehension and can be described as relentless with the two 30-minute web-based ITSS lessons, large numbers of lessons (with varying levels of readability) available for the adaptive tutoring, customized feedback, and further supported by teachers trained to apply structure strategy lessons with their regular curriculum materials and to provide ongoing feedback to students. Finally, the ITSS tutor is uniquely able to match student needs with instruction.

Successful high-need schools focus on science vocabulary growth, reading strategies, concerted time and attention on task, and individual attention and customization for learners (e.g., Cunningham, 2006; Denton, Foorman, & Mathes, 2003; Gambrell, Morrow, & Pressley, 2007). Again, ITSS has a broad range of science topics and difficulty levels of texts and provides vocabulary assistance when necessary. With the teachers receiving strong and high quality MOOV PBPD followed by coaching and co-teaching support throughout the implementation phase we address the most pressing needs of these schools and students,

B.6. Components of MOOV address comprehensive needs to make an impact

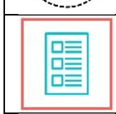
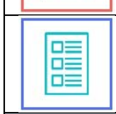
Web-based technologies for providing consistent, high-quality instruction with modeling, practice, assessment of learning, feedback, and scaffolding provides the foundation for this MOOV proposal. Our MOOV infrastructure was developed through multiple grants to the endowed Center for Urban School Partnerships at Texas A&M University. Within this infrastructure we have modeling videos, webinars, chat rooms, ITSS teacher lessons, animated pedagogical agents, and well-designed PBPD instruction for teachers and school support personnel. We also have synchronous and asynchronous activities designed to build a sustainable support system for teachers implementing these practices.

During synchronous interactions experts on text structure-based science reading comprehension instruction that meet the What Works Clearinghouse standards will conduct webinars about how the intervention works and respond to questions from the audiences. During practice sessions, the participants (e.g., teachers) will interact with the web-based ITSS with special teacher science lessons to practice how the interventions function. Additional follow-up will be presented through video modeling of how to use these methods in a classroom setting. Teachers will complete lesson plans for implementation in their classrooms by identifying topics of interest, seeking and organizing information, and selecting ITSS lessons or creating new ITSS lessons. These plans will be assessed by the expert team, and teachers will receive feedback and guidance on implementation options. When the MOOV course is complete, teachers will receive micro-credentials for completing the course (e.g., badge for reading comprehension strategy knowledge). The MOOV infrastructure is available for 2 years beyond the course for participants to create a collaborative community and receive guidance during school year implementation. During this extended support period, project team members and the school leaders will coach or co-teach classes with teachers as needed via video or face-to-face.

B.7. MOOV Goals and Objectives are Specified, Aligned, and Measurable

The MOOV goals are focused on increasing the number of highly effective science teachers at upper elementary grades who are serving high-need schools. We use a unique blend of web-based and face-to-face PBPD for teachers, teacher leaders, and school instructional leaders to achieve these goals. We further allow customization of learning to context for teachers and students improving the opportunities to succeed. The project focuses primarily on all areas of science reading comprehension in the content areas with support for vocabulary and decoding (through narration on the ITSS). Further we support monolingual English speakers, bilingual Spanish speaking English learners, and American Indian children attending schools on reservations in New Mexico (see attached letters of support). Table B1 presents our goals and Tables D1 and D2 present data collection plans and measures aligned with the goals and research questions for both formative and summative evaluation. Table B3 presents micro credentials that can lead to formal certifications (e.g., Dyslexia Certification) and advanced degrees (e.g., Texas A&M Online Master's Degree in Curriculum and Instruction), we anticipate improving the school circumstances related to poverty and high-need. By increasing the adoption of text structure-based science reading comprehension strategies in all upper elementary grade classrooms, application of well-researched instructional practices, and school supports that increase the likelihood of sustainable changes in literacy practices, we anticipate positive outcomes in the highest need communities. Figure B1 presents the logic model for this project and shows the alignment of all the components.

Table B3: Micro Credentials and Pathway to Advanced Degrees and Lifelong Learning for Teachers in High Need Schools

Micro-credential			
Badge	**Requirements**	**Estimated Time to earn badge**	**Details**
	Complete 10 ITSS science lessons with 80% accuracy	.5 day	Shows competence in TSS for science
	Complete 10 ITSS SPED lessons with 80% accuracy	.5 day	Shows competence in TSS for students with learning disabilities
	Complete 10 ITSS EL lessons with 80% accuracy	.5 day	Shows competence in TSS for Els
	Complete all ITSS lessons with 80% accuracy	1.5 days	Top 20% of badge earners will be invited to participate in TAMU online Master's program
	Have 10 science lesson plans approved	2 days	Approved lesson plan badges will be shared with schools to promote teacher leaders Approved lesson plan badges differentiate highly knowledgably individuals in the community from novices. Crowd sourcing intellectual capital on topics validates teacher expertise and reinforces value of their role in community
	Have 10 SPED focus lesson plans approved	2 days	
	Have 10 EL focused lesson plans approved	2 days	
	Have 20 science+Spanish lesson plans approved	4 days	
	Have 20 SPED+Spanish focus lesson plans approved	4 days	

Macro-credentials and certifications			
Credential/ Certification	**Focus**	**Institution**	**Details**
Online M.Ed	Curriculum and instruction	Texas A&M U.	Focus in science or reading and literacy
M.Ed/M.S.	Curriculum and instruction focusing on STEM or	Texas A&M U.	Students will have the option to purse a Reading Specialist Certification and Master Reading

	Literacy		Teacher Certification
Reading Specialist Certification	Components of Reading Assessment and Instruction Strengths and Needs of Individual Students	State of Texas	Course requirements for the Reading Specialist certification are met through the Reading and Language Arts M.S./M.Ed. program at Texas A&M U. Texas A&M Program has 100% pass rate
Master Reading Teacher certification	Foundations of Reading Knowledge and Instruction Principles of Instructional Design, Delivery, and Assessment in Reading Reading Instruction and Assessment for Students with Diverse Backgrounds/Needs	State of Texas	Course requirements for the Master Reading Teacher certification are met through the Reading and Language Arts M.S./M.Ed. program at Texas A&M University Program has 100% pass rate

B.8. Theoretical Foundation for MOOV

As noted earlier, PBPD is based on sociocultural theories of learning applied to teacher preparation and professional development. In the areas of reading comprehension these theories share foci on teacher factors related to reading comprehension proposed by other researchers. Aaron, Joshi, Gooden, and Bentum (2008) proposed an expanded Simple View of Reading referred to as the Component Model of Reading (CMR), by including psychological and ecological components which also affect the acquisition of literacy skills. The ecological component is made up of the home environment, **culture**, parental involvement, **classroom environment**, peer influence, dialect, and **English as a second language**. MOOV PBPD addressed the culture, classroom environment, and ESL factors.

C. Management Plan – Evidence of Personnel, Resources, and

C.1. Qualifications of Project Personnel

Name, Role, and Institution	Qualifications and Responsibilities
Dr. Kausalai Kay Wijekumar, PI and Professor of Teaching, Learning, and	Dr. Wijekumar has served as the PI for 3 recently completed IES grants and 2 current IES grants related to literacy. Dr. Wijekumar holds a BS in Electronics Engineering, a M.S. in Computer Science, and a PhD in Instructional Systems. Her varied background in STEM disciplines blended with her passion for improving schools gives her a unique perspective to make this project a success. She architected the MOOV and ITSS

Culture and Director of the Endowed CUSP at Texas A&M University	technologies and served as the manager of the studies. She served as PI for a RCT with 124 classrooms examining the effectiveness of the Odyssey math software with 4th grade children across the Mid-Atlantic region conducted under the auspices of the Regional Educational Laboratory Mid-Atlantic (2006-08). Both large scale RCTs lead by Dr. Wijekumar have been reviewed by the What Works Clearinghouse and deemed to meet evidence standards without reservations. Dr. Wijekumar will manage the full project, recruit schools, supervise the management of the MOOV & ITSS infrastructures, conduct teacher professional development, and disseminate findings through the CUSP.
Dr. Hersholt Waxman, Co-PI is Professor of Teacher Education at Texas A&M University and Director of the ERC	Dr. Waxman has served as Associate Dean for Research and Director of the Educational Research Center at the University of Houston and as a Principal Researcher and Senior Research Associate at the National Research Center for Education in the Inner Cities and the National Center for Research on Education, Diversity, and Excellence. Waxman has authored or co-authored more than 150 journal articles in the areas of urban education, effective schools and teaching, classroom learning environments, teacher education, and students at risk of failure. Dr. Waxman will lead the evaluation team and manage all the aspects of the testing, classroom observations, and data collection.
Dr. Anita Hernandez, Co-PI Professor of Education, New Mexico State University	As the Don and Sarrah Kidd Chair in Literacy she brings extensive experience working in reading and literacy education, bilingual education, and in the education of English learners. She is the co-author of two literacy professional development. She has completed two I3 grants in New Mexico and is currently the project director of a five-year $1.8 million National Professional Development grant. Dr. Hernandez will lead the team in NMSU to work in supporting the schools and support the team with supports for Spanish speaking Els.
Dr. R.M. Joshi, Co-PI Professor, Texas A&M University	Dr. Joshi is an expert in Special Education research and has widely published research about literacy. He has landmark publications on the ecological factors related to comprehension as well as the Simple Vide of Reading. He serves as Editor of Reading and Writing: An Interdisciplinary Journal and Literacy Studies: Perspectives from Cognitive Neurosciences, Linguistics, Psychology, and Education. Dr. Joshi will support the team on adaptations for children with disabilities as well as high poverty areas and teacher knowledge.
Dr. Debra McKeown	Dr. McKeown, Associate Editor of Journal of Early Intervention, is an expert at practice-based professional development (PBPD) and the Self-Regulated Strategies Development (SRSD) approach to instruction. She will support the development of new materials, conduct PBPD sessions, and outreach to schools.
Dr. Joanne Olson	Dr. Joanne Olson is a professor in science education and the former president of the Association for Science Teacher Education. Her research efforts focus on: science methods, advanced pedagogy, curriculum theory, research design, and science content courses. Her K-12 teaching experience includes five years at the middle school and elementary school levels in

	multicultural urban and suburban public school settings.
Dr. Herbert W. Turner, III. Analytica Inc.	Dr. Turner is a renowned methodologist who has worked with numerous Regional Educational Laboratories on large scale randomized controlled trials. He will conduct quality assurance on all aspects of the evaluation.
Dr. Bonnie J.F. Meyer	Dr. Meyer is the pioneer architect of the text structure strategy and remains a strong voice in reading comprehension. She will support the team by delivering webinars and also advising on customized lesson development in science and special educataion.
Dr. Puiwa Lei	Dr. Lei is an expert methodologist who has supported over 20 large scale randomized controlled trials. She will service as the methodologist for the MOOV project.
Dr. Jennifer Cromley	Dr. Cromley was awarded a Presidential Early Career Award for Scientists and Engineers in 2010. Her 6 IES-and NSF-funded research projects since 2008 have focused on cognitive and motivational predictors of STEM grades and retention, as well as learning from text and diagrams. Dr. Cromley will assist the team on science learning strategies.
Dr. Elsa Hagan	Representing the International Dyslexia Association, she will advise the team on lesson adaptations for students with dyslexia. Dr. Hagan will advise the team on special education as well as Spanish speaking Els
Dr. Peggy McCardle	Dr. McCardle has worked extensively with American Indian Reservation schools and will advise the team about adaptations for children in those schools and Spanish speaking Els

C.2. Evidence of Resources to Successfully Conduct the PD, Research Study, Data Analysis, and Dissemination

C.2.1. Partner Institutions and Resources

This proposal is being submitted by Texas A&M University (CUSP & ERC) in collaboration with New Mexico State University, Analytica Inc., and the International Dyslexia Association The combined resources of all locations provide all necessary support to accomplish the goals of this project. The College of Education and Human Development at Texas A&M University has strong cooperative relationships with school districts across Texas and has invested significant resources in encouraging researcher practitioner partnerships with schools. The Center for Urban School Partnerships endowed by the Houston Foundation and housed within the TAMU-CEHD is led by the PI Wijekumar and has conducted outreach to schools with conferences, school support meetings, online resources, and MOOV courses for disseminating results from the recently completed IES funded projects (ITSS, We-Write, and SWELL). The CUSP has a sophisticated video conferencing setup, support personnel (e.g., research associate, budget administrator), and meeting rooms. The Education Research Center (ERC) led by Dr. Waxman focuses on research and evaluation services with an extensive network of personnel for data collection. Dr. Puiwa Lei (methodologist) will work with the independent firm Analytica Inc. to conduct random assignment, quality assurance checks during pre and posttests, conduct fidelity observations, data cleaning, analysis, and reporting. Dr. Wijekumar, Lei, and Turner (Analytica) have each worked on previous projects that have been reviewed by the WWC and are familiar with the standards. Dr. Cardenas-Hagan will represent the IDA to support the MOOV team about lesson adaptations for students with dyslexia.

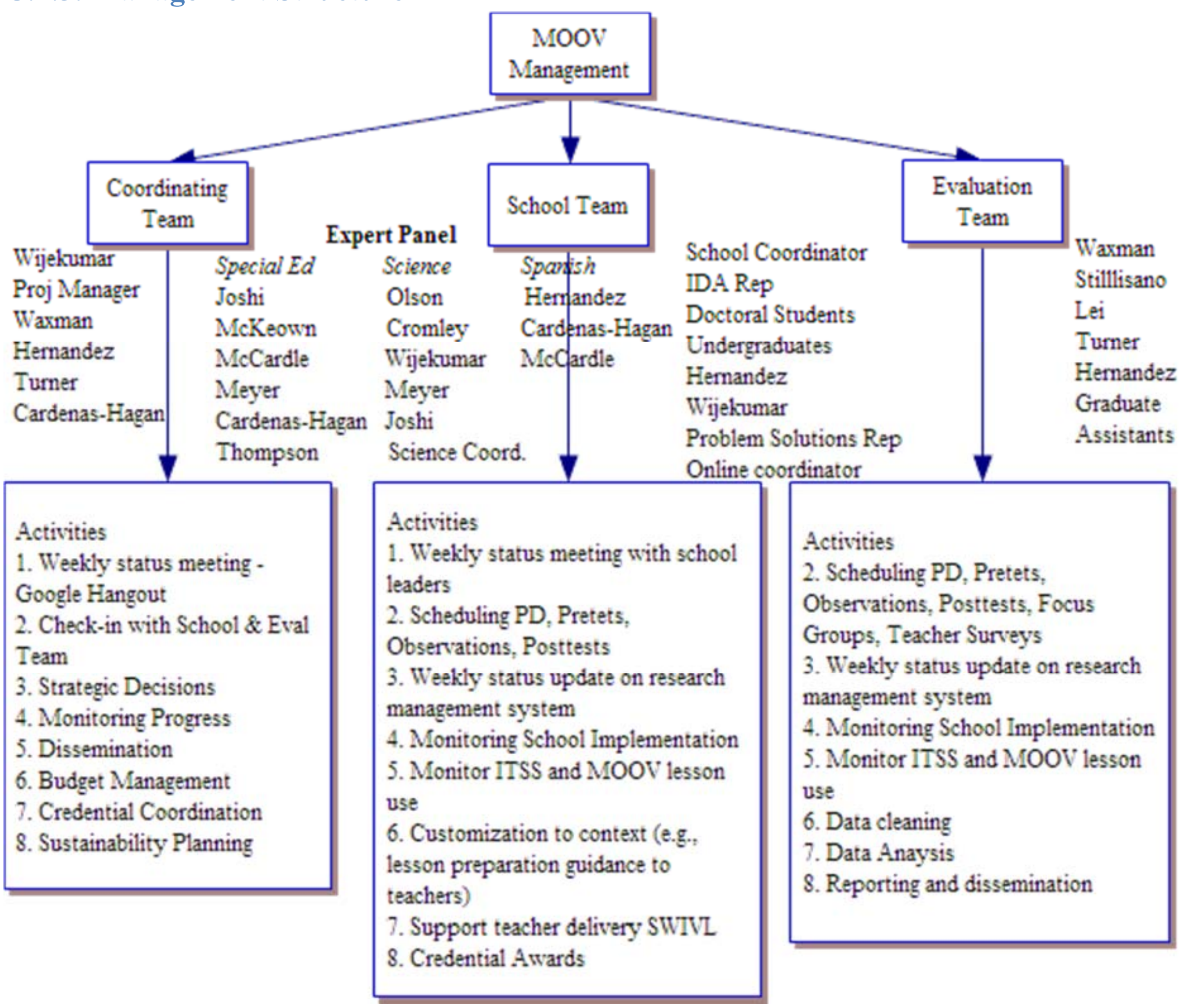
The MOOV platform was designed and developed by Problem Solutions, Inc. and they will continue to maintain, enhance, and support this project. Problem Solutions Inc., has an expert group of programmers, designers, and school technology support personnel who will work with this team to ensure 24/7 support of all technologies. TAMU-CEHD provides full video capabilities including animation design, technology support for outreach and delivery of webinars. TAMU also has library facilities, virtual servers, and computer resources to support this project. Coordination of the project between Texas and New Mexico will be conducted by Dr. Wijekumar and Project Manager via weekly meetings using Google Hangouts. The logistics for school rollouts, computer lab checks, PD schedules, testing, observations, and data quality checks will be handled via the research management system built by Dr. Wijekumar for the recently completed IES funded ITSS efficacy studies.

C.2.2. Collaboration Platform

The MOOV team will utilize a dedicated conference room housed within the CUSP offices. Available communication tools include – Skype, Goto Meeting, SWIVL, Web-cams and

Google Hangouts. Dropbox and Google Docs. The team will also utilize a Dropbox based platform for sharing documents within the team and weekly reports and minutes from meetings. Finally, CUSP hosts a research management platform that was designed by Dr. Wijekumar for previous efficacy studies. The system allows transcription of tests, computer scoring of tests, and human coding of videos and textual results. The system is capable of uploading and downloading scanned documents (e.g., Texas STAAR science test). The system is a valuable asset when large volumes of tests are processed and allows quick and easy monitoring of student, classroom, and/or school level changes in participation throughout the project.

C.2.3. Management Structure



D. Project Evaluation

The MOOV project evaluation will be composed of formative and summative data collection. The RCT (summative) will be headed by Dr. Waxman (Director of the Education Research Center –ERC, at Texas A&M University) in collaboration with Dr. Lei (methodologist) and Analytica Inc., an independent evaluation and research firm. The ERC and Analytica will collect all of the data for the impact evaluation. Dr. Puiwa Lei the team's methodologist (The Pennsylvania State University) will work closely with Analytica on the data analysis for the evaluation. The MOOV team will collaborate with Dr. Lei and Analytica on the research design, analytic approach, reporting for the evaluation, and will carry out ongoing formative assessment activities to inform project design and improvement. Analytica, Inc., specializes in the design, implementation, analysis, and reporting of impact evaluations to test what works. During the past decade, Analytica's staff have contributed to numerous federally and privately sponsored large-scale impact evaluations throughout the US. Analytica's expertise span all phases of an impact study including, design, OMB clearance, recruitment, implementation, analysis and reporting and meeting WWC Standards. As the independent evaluation monitor, Analytica will ensure that the impact evaluation is implemented as designed.

The evaluation team will produce evidence that meets WWC evidence standards through a study that will minimize overall and differential attrition, establish baseline equivalence between MOOV and control schools in the analysis sample, use reliable and valid student and teacher outcome measures that are not over-aligned with the intervention and are collected in the same manner for both intervention and comparison groups, and control for confounds (measured and unmeasured) through random assignment. We will make every effort to address the newer WWC Standards for Cluster Studies related to the issue of "stayers" and "joiners". Within this definition, schools present at the time of random assignments are called "stayers" and schools that enter the project after random assignment are called "joiners." Since cluster RCTs with just "stayers" (and no joiners) can meet WWC standards without reservations, we will ensure through the timing of our random assignment and analysis of data only includes stayers at the school, classroom, and student levels.

D.1. Formative and Summative Data

D.1.1. Formative evaluation related research questions

Implementation Study

1. Are teachers knowledgeable about text structures and the use of text structures as a strategy to improve reading comprehension?
2. To what extent were MOOV and ITSS text structure activities implemented with fidelity throughout the evaluation sites?
3. How many lessons and resources from the MOOV and ITSS platforms are used by participating teachers and how often are they used?
4. What factors facilitate or undermine effective implementation of MOOV and ITSS?

Formative Assessment and Capacity Building

5. To what extent do teacher leaders and administrators participate in planned MOOV activities such as webinars, quarterly MOOV status meetings, and weekly school planning and update meetings?
6. To what extent do teacher leaders and administrators engage other grade level teachers (grades 1 to 4) in MOOV activities?

D.1.2. Summative evaluation RCT research questions and data sources

Primary confirmatory research question related to cognitive outcomes:

Do grade 4 and grade 5 students in high-need schools using the MOOV-ITSS intervention (teacher-led and computer supported) outperform students in control schools on measures of science reading comprehension (e.g., Texas STAAR Science Test, main idea quality)?

a. What are the effects of MOOV-ITSS compared to control for fifth grade students (i.e., Year 1)?
b. What are the effects of MOOV-ITSS compared to control for fourth grade students (i.e., Year 2)?

After addressing the primary research questions and follow-up questions that pertain to the *cognitive outcomes*, we will evaluate MOOV-ITSS with respect to important *motivation and self-efficacy outcomes* with fourth and fifth grade students.

a. What are the effects of MOOV-ITSS on motivation and self-efficacy measures compared to control for fifth grade students (i.e., Year 1)?
b. What are the effects of MOOV-ITSS on motivation and self-efficacy measures compared to control for fourth grade students (i.e., Year 2)?

We will further explore the impact of the MOOV-ITSS on teacher practices

a. What is the impact of MOOV-ITSS on teachers' instructional practices and use of the text structure strategy among fourth and fifth grade ELA and science teachers?
b. Is the time on text structure instructional practices observed during classroom instructional time correlated with student science outcomes?

Table D1: Milestones and Activities (presented for year 1 grade 5 classrooms will be repeated for year 2 grade 4 classrooms)

Dates	Project Milestones	Responsible Group	Measures
July 2018 Y1	Project Kickoff Finalize School MOU	School Team	Number of signed MOUs
Aug 2018 Y1	Random Assignment MOOV PD for Intervention Schools Award credentials	Analytica & Eval Team School Team	Number of PD Attendees ITSS Lesson Completion for teachers Video reflection coding
Sept 2018 Y1	Pretest 5th grade during year 1 for stayers (4th grade data collection during	Eval Team	Student – TX STAAR, NM-PARCC Researcher Measures,

	years 2)		Surveys Teacher – Surveys
Oct 2018 - Feb 2019 Y1	ITSS Implementation in intervention schools 5th grade Gather quarterly implementation data	School Team Eval Team	Weekly check-in + SWIVL support Coaching/co-teaching Observations, quarterly surveys
	Control schools	Eval Team	Observations, quarterly surveys
Mar 2019 Y1	Posttests (5th grade year 1) Data analysis to include stayers only (based on their enrollment in previous year)	Eval Team	Student – TX STAAR, NM-PARCC Researcher Measures, Surveys Teacher – Surveys
June – Aug 2019 Y1	Follow-up with schools on implementation factors Teacher credentials (e.g., certifications)	School and Eval Teams School Team	Documented implementation, Coding videos and MOOV posting, Number of certificates awarded
Aug 2019 to Mar 2020 Y2	Repeat year 1 activities with 4th grade team Provide full MOOV-PBPD to all grade level teachers in intervention schools	School Team and Eval.Team School Team	Pre & Post Tests Dissemination activities and attendance (e.g., School Impact Summits)
April 2020 to June 2021 Y3	Finalize data analyses Report findings Provide full MOOV-PBPD to control schools Setup long-term plan for MOOV-ITSS	Eval Team Eval Team School Team School Team	Results meeting WWC standards without reservations Number of attendees Platform for long-term dissemination

D.2. Valid and Reliable Data

The team will utilize the tools and resources used in previous IES funded studies that produced powerful results. Table D2 presents highlights of measures, brief descriptions, and reliability information for each measure.

Table D2. Measures and Reliability from Previous Studies

Measure Type	**Measure Name & Description**	**Reliability**
	Student Measures	
Standardized Test	Texas STAAR Science Test (computer scored) Two equivalent released forms (or New Mexico PARCC Science)	.88-.92

	Texas STAAR & New Mexico PARCC Reading Score	.89- .91
Experimenter-Designed Measures 2 tests with 2 equivalent passages each Computer scored	Comparison Text Structure Signaling Word	.99
	Main Idea Quality on Comparison Text Structure	.95
	Comparison Competence from Full Recall of Text	.83 - .98
	Comparison Top-Level-Structure from Full Recall of Text	.99 – 1.00
	Problem and Solution Text Structure Problem and Solution Competence	.87
Affective Measures[b]	Structure Strategy & Science Self-Efficacy	.75
	Motivation to Read (items 7, 9, 13, & 15 from Gambrell, Palmer, Codling, & Mazzoni, 1996	.77-.78 for reading self-concept
Teacher Measures		
Teacher survey (demographics, text structure & science knowledge, interest, years of service, efficacy)		
Teacher bi-weekly log (MOOV +ITSS lessons used, coaching, co-teaching		
ITSS Comprehension– e.g., Main idea, Signaling words Scored by computer		.99
Classroom observations –SWIVL and tablet based observation of time spent on key science literacy indicators and focus on fidelity of TSS instruction		

D.2.1. Cognitive outcome for research questions.

Reading and science comprehension will be measured using a science and language arts test (e.g., Texas STAAR released test or New Mexico PARCC science) test with multiple-choice questions. Science reading comprehension will also be measured using experimenter-designed signaling word knowledge, recall of text, and main idea tests about science texts. Details about these measures are available in Wijekumar, Meyer, & Lei, 2012 attached to this proposal.

D.3. Key Moderators or Mediators

Key moderators that will be used in the data analyses include initial reading and science level of student, gender, teacher years of teaching experience, teacher knowledge of science and text structure, and school characteristics such as percentage of students receiving free or reduced-price lunch and average initial school reading level.

Potential mediating effects can be detected by using both cognitive and affective/conative outcomes at two time points (pre-, post-test). Cognitive and affective/conative measures can be mediators for each other.

D.4. Implementation Fidelity and Comparison Group Practices Study

Based on our experiences during the recently completed efficacy study we have carefully revised our approach to gathering data about fidelity of implementation and comparison group. This proposal includes a plan to conduct a survey of all teachers on teacher experience, knowledge and use of science comprehension practices, and science curricula materials used in the classrooms (both intervention and control). The second component is a strengthened approach to conducting observations in both intervention and control classrooms using specific observation instruments. The revised fidelity of implementation measures will include two different forms. 1) Observing the computer laboratory time using ITSS. 2) Observing both intervention and control classrooms during instruction on science reading comprehension. Finally, a MOOV web-based bi-weekly teacher log will be used to gather data about teacher practices. These forms now carefully document the content and practices used within the classroom setting during the observation period and gather information about the fidelity.

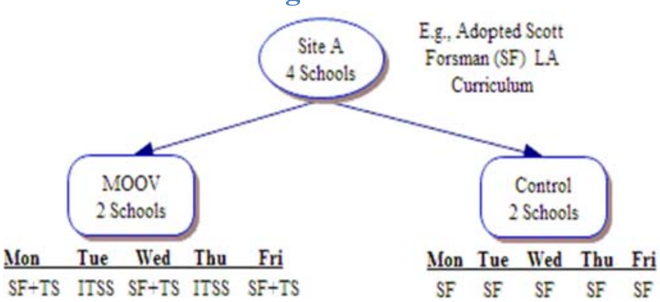
D.5. Research Plan that Produces Rigorous Data

D.5.1. Sample and Setting

All students will be recruited through cooperating schools in New Mexico and Texas. We have received commitment from five school districts to participate in the MOOV project and they all serve large numbers of disadvantaged students. As an incentive for schools to participate, they will receive access to the software and support for implementation at no cost and the control schools will receive all the MOOV during year 3. Timing of access will be in accordance with the experimental design.

In addition to recording school district, type of district, school building, classroom, and teacher codes for the estimated 5000+ students per grade level who will participate in this investigation, we will also collect data on gender, ethnicity, learning disabilities, SES indicators (e.g., free or reduced-price lunch), and school-based reading comprehension assessments (e.g., ForeSight tests). Additionally, we will collect teacher data (e.g., self-reported years of teaching experience and level of expertise about science ad text structure). We will also collect data from the teacher ITSS during the MOOV (e.g., videos). Teacher knowledge of science, signaling words, quality scores on main ideas, and recalls will be used in the data analysis.

D.5.2. Research Design that Meets the WWC Evidence Standards Without Reservation



We will use a *Multi-Site Cluster Randomized Trial (CRT)* design with treatment at the school level (level 3) to test the effectiveness of MOOV-ITSS as shown in Figure 2. For each grade level, schools are randomly assigned to experimental conditions (MOOV-ITSS or business as usual control) within sites (smaller units than District).

D.5.3 Power Analysis

Analyses, based on the studies conducted as part of the IES Efficacy Grant for ITSS, show that effect sizes of ITSS on cognitive measures (TX STAAR, main idea competency and quality) range from .10 to .49 for grade 4, .20 to .53 for grade 5. We used effect size estimates for the cognitive measures because they are the main outcomes of interest. Two effect size values (d =.24 and d =.3) that are in the observed range were considered in the power analyses shown in Table D3. Our estimated combined (classroom and school levels) intraclass correlations, based on our previous data on the cognitive measures, ranged from .07 to .10 (school level: .00 - .02;

classroom level: .05 - .10) for fourth grade schools, and from .05 to .10 (school level: .00 - .01; classroom level: .04 to .10) for fifth grade, from .09 to .14 (school level: .02 - .03; classroom level: .07 to .13) for seventh grade, and from .09 to .16 (school level: .00 - .02; classroom level: .07 to .16) for eighth grade schools. Therefore, power analysis results for two combinations of intraclass correlation levels (ρ_{level2}=.10, ρ_{level3}=.02 and ρ_{level2}=.16, ρ_{level3}=.03) were compared. We chose the highest observed ICCs within 4-5 and 7-8 grades to be conservative. The software program Optimal Design (OD; Spybrook, Bloom, Congdon, Hill, Liu, Martinez, & Raudenbush, 2005-2011) was used to estimate the number of sites needed for the *Multi-Site (with Treatment at level 3) CRT* design with the following assumptions:

Table D3. Power Analysis for Multi-Site CRT (alpha=.05)

Fixed effect				
	ρ_{level2}=.10, ρ_{level3}=.02		ρ_{level2}=.16, ρ_{level3}=.03	
	# Schools	# sites	# Schools	# sites
d=.24				
R^2=.00	40	10	52	13
R^2=.36	40	10	48	12
d=.30				
R^2=.00	28	7	36	9
R^2=.36	28	7	36	9
Random effect				
	ρ_{level2}=.10, ρ_{level3}=.02		ρ_{level2}=.16, ρ_{level3}=.03	
d=.24				
R^2=.00	48	12	60	15
R^2=.36	44	11	56	14
d=.30				
R^2=.00	36	9	44	11
R^2=.36	32	8	40	10

Note. R^2 is proportion of the variance explained by the level 3 covariates.

1. Statistical power is .80;
2. Statistical significance level is at α = .05 for a two-tailed test;
3. Each classroom includes 20 students but with a 25% attrition rate at posttest such that 15 students per class will provide both pretest and posttest data;
4. Each school includes 4-10 classrooms;
5. Balanced allocation with two schools per experimental condition within each school site;
6. Minimum detectable effect size d=.24 and .30;
7. Explanatory power (R^2) of school level covariates (e.g., school level pretest) = .00 and .36.
8. Proportion of variance explained by the blocking variable is assumed to be 0 (conservative).
9. Intraclass correlation (ρ) values: ρ_{level2}=.10, ρ_{level3}=.02 and ρ_{level2}=.16, ρ_{level3}=.03.
10. Power analyses are presented for both fixed and random effects. For random effects analysis, we assumed effect size variance to be .01 across sites.

In the HLM analyses, we will also include the student level pretest covariates (which are expected to be highly correlated with the posttest scores) for all models to increase power of the test for treatment effect (Raudenbush, 1997). Therefore, the estimates presented in Table D3 tend to be on the conservative side. It appears that the number of sites we need per grade level is between 7 and 15 and the number of schools we need is between 28 and 60. Because three of the committed school districts are large (about 30 schools each), we will match schools within district based on school characteristics (e.g., % students received free or reduced-price lunch, school locale) and group four similar schools into a site (as four schools per site were assumed in the power analysis) before random assignment of schools to treatment conditions within site. We expect our sample sizes at student, school, and site levels to be sufficient to evaluate treatment efficacy at each grade level (i.e., grades 4-5).

D.5.4. Data Analysis

As indicated earlier, we will use a *Multi-Site Cluster Randomized Trial (CRT)* design with treatment at the school level (level 3) to test the effectiveness of MOOV. For each grade level, schools are randomly assigned to experimental conditions within sites.

At present, five school districts have indicated support of the proposed research effort. We expect a total of 56 schools to participate. There are about 10 classrooms within each school, and 20 students within each classroom per grade level. Therefore, approximately 4,480 students from the districts (i.e., 56 schools x 10 classrooms per school x 20 students per classroom) are scheduled to participate in this MOOV-ITSS project at each grade level.

To determine if there are differences between intervention conditions with respect to reading comprehension outcomes (standardized test and experimenter-designed reading measures) and affective outcome measures (reading efficacy, computer attitudes, and motivation to read), a series of hierarchical linear modeling (HLM: Raudenbush & Bryk, 2002) equations will be specified. A set of analyses will be run for each of the posttest outcomes for each grade level.

HLM Model Specifications: Addressing Primary and Secondary Research Questions

For the HLM models, students are nested within classrooms, classrooms within schools, and schools are nested within sites. Because of the modeling complexity attributed to four-level structures, we will test initially the degree to which sites differ on each of the outcome variables using an unconditional four-level model. Should the test of the outcome variance at the site level demonstrate non-significance, we will simplify the models to three levels. Otherwise, we will analyze four-level models.

At the student level, predictor variables will include gender (and other demographic variables such as ethnicity and special education status, which will be modeled similarly as gender in this level; only gender will be described here for simplicity), reading comprehension pretest covariates (e.g., experimenter-designed measures), and affective/conative pretest covariates (e.g., motivation to read and structure strategy efficacy).

Using Raudenbush and Bryk (2002) nomenclature,

Level 1 (student level) equation is:

$Y_{ijkl} = \pi_{0jkl} + \pi_{1jkl}(gender)_{ijkl} + \pi_{2jkl}$ (experimenter-designed measure *pretest*)$_{ijkl}$ + π_{3jkl} (reader self-concept/motivation pretest)$_{ijkl}$ + π_{4jkl} (structure strategy self-efficacy pretest)$_{ijkl}$ + e_{ijkl}

where Y_{ijkl} is the outcome for student *i* in teacher *j*'s class in school *k* in site *l*, π_{0jkl} is the average adjusted outcome of students in teacher *j*'s class in school *k* in site *l*, π_{1jkl} is the difference in outcome scores between male and female students in teacher *j*'s class in school *k* in site *l*, *gender* is a grand-mean centered indicator variable (1=female, 0=male), π_{2jkl} is the effect of student-level experimenter-designed measure pretest scores in teacher *j*'s class in school *k* in site *l*, experimenter-designed measure pretest is group-mean centered, π_{3jkl} is the effect of student-level self-concept/motivation pretest scores in teacher *j*'s class in school *k* in site *l*, reader self-concept/motivation pretest is group-mean centered, π_{4jkl} is the effect of student-level structure strategy self-efficacy pretest scores in teacher *j*'s class in school *k* in site *l*, structure strategy self-efficacy pretest is group-mean centered, e_{ijkl} is a random error associated with student *i* in teacher *j*'s class in school *k* in site *l*, and $e_{ijkl} \sim N(0, \sigma^2)$.

The classroom average outcome in a school estimated by the level 1 intercept π_{0jkl} is modeled as varying randomly across teachers at level 2, the teacher level. At the teacher/classroom level, classroom characteristics (e.g., teacher experience, class-level pretest scores) will be included.

Level 2 (teacher level) equation is:

$\pi_{0jkl} = \beta_{00kl} + \beta_{01kl}$ (teacher experience)$_{jkl}$ + β_{02kl} (class mean of experimenter-designed measure pretest)$_{jkl}$ + β_{03kl} (class mean of reader self-concept/motivation pretest)$_{jkl}$ +β_{04kl} (class mean of structure strategy self-efficacy pretest)$_{jkl}$ + r_{0jkl}

$\pi_{1jkl} = \beta_{10kl}$

$\pi_{2jkl} = \beta_{20kl}$

$\pi_{3jkl} = \beta_{30kl}$

$\pi_{4jkl} = \beta_{40kl}$

where β_{00kl} is the adjusted average student outcome across all teachers' classrooms in school *k* in site *l*, β_{01kl} is the effect of teacher experience (grand-mean centered) on classroom average student outcome in school *k* in site *l*, β_{02kl} is the effect of the mean classroom experimenter-designed measure pretest score (group-mean centered) on classroom average student outcome in school *k* in site *l*, β_{03kl} is the effect of the mean classroom reader self-concept/motivation pretest score (group-mean centered) on classroom average student outcome in school *k* in site *l*, β_{04kl} is the effect of the mean classroom structure strategy self-efficacy pretest score (group-mean centered) on classroom average student outcome in school *k* in site *l*, and r_{0jkl} is a random error associated with teacher *j*'s classroom in school *k* in site *l* on classroom average student outcome, $r_{0jkl} \sim N(0, \tau_{\pi 00})$.

The school average outcome in a site estimated by the level 2 intercept β_{00kl} is modeled as varying randomly across schools and as a function of intervention condition at level 3, the school level. Additionally, school characteristics (e.g., percent students received reduced-price lunch, school-level pretest scores) will be examined at this level. Potential cross-level interaction effects between treatment and student level variables (e.g., whether treatment effect varies depending on initial reading level; whether treatment reduces gender gap in reading) will also be explored by modeling level-1 coefficients as a function of treatment. Similarly, potential cross-level interaction effects between treatment and class level variables (e.g., whether treatment effect varies depending on teacher experience) will be explored by modeling level-2 coefficients as a function of treatment. Potential interaction effects between treatment and school characteristic variables will be examined by adding product terms at the school level.

Because our analyses include both cognitive and affective outcomes measured at different time points, potential mediating effects can be detected by examining the pattern of significant effects. For example, if affective variables mediate treatment effect on reading, treatment effect on the affective variables would be significant, and the effect of affective variables on reading would be significant. If any potential mediation effects are noted, we will use structural equation modeling to further examine the mediation effects.

In addition, we will estimate effect size of *MOOV* as compared to the business-as-usual comparison group. Specifically, we will compute the effect size as a standardized mean difference by dividing the adjusted (for pretest scores and other covariates) group mean difference by the unadjusted *pooled* within-group student-level standard deviation of the outcome measure (i.e., Hedges' g if standard deviations are similar for all treatment conditions) or by the *comparison* group student-level standard deviation (i.e., Glass' delta if standard deviations are very different; e.g., Lipsey & Wilson, 2001).

Missing data will be handled by listwise deletion if the percentage of missing data is 5% or less and the missing pattern is completely at random (MCAR) or by multiple imputation if missing is at random (MAR). Assessment of attrition will be conducted on analysis sample prior to adjustments for missing data (listwise or MI). We will calculate overall and differential attrition on the analytic sample (between treatment conditions) rates and determine whether attrition is considered low or high using WWC's latest criteria, at the cluster level and subcluster levels. If attrition rate is higher, we will assess baseline equivalence of the intervention and comparison groups on demographic characteristics and pretest scores with the analytic sample All baseline characteristics that show nonequivalence of larger than .05 effect size (i.e., Hedges' g for continuous variables or Cox index for dichotomous ones) will be included as covariates in all HLM analyses (i.e., statistical adjustment) to minimize bias in the impact estimates. We will limit the number of transfers into the research condition

The Benjamini-Hochberg adjustment (B-H; Benjamini & Hochberg, 1995) will be used to control the false discovery rate in testing multiple hypotheses. The B-H procedure is more powerful than the Bonferroni technique (Williams, Jones, & Tukey, 1999) and has been adopted in many research studies.

Conclusion

This proposal addressed absolute priority 1 Teacher Knowledge, competitive priority STEM, and invitational priority of the SEED competition 2018. Our plans to support over 2800 teachers to learn, customize/individualize, reflect, and create a sustainable change to science comprehension instruction within the upper elementary grades is an essential and important goal.

We use the efficacious ITSS platform to support both teachers and students and use the MOOV platform as the wraparound method to provide cost effect and high-quality instruction as needed to teachers across high-need schools. We further support their implementation throughout the school year. Finally, we have planned a strong research study that meets WWC standards without reservations to study the effect of this approach.

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