ASMS EFFICACY STUDY

An Efficacy Study of a Comprehensive Middle School Science Curriculum that Integrates Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts

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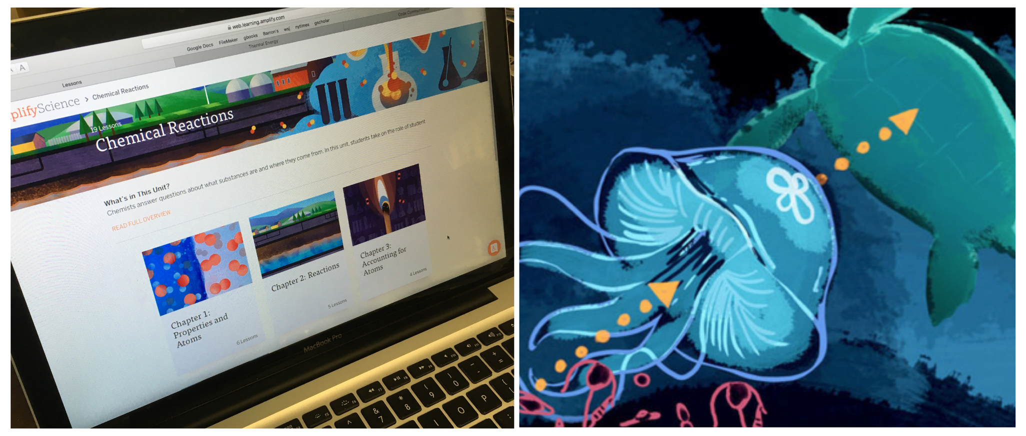
Overview

The Next Generation Science Standards (NGSS Lead States, 2013) recast science proficiency as not only what students know, but also how they can use and apply what they know. Teachers will need high-quality curriculum materials to help them create instructional experiences that will engage students in this new form of learning. At this time, few curriculum materials have been designed expressly for meeting the NGSS, and thus there is limited evidence-based research on the efficacy of NGSS-designed curricula.

This project is an effort to design and conduct a large-scale study of the impact of the Amplify Science Middle School (ASMS) curriculum on teaching and learning. Designed by the Lawrence Hall of Science in collaboration with Amplify Education Inc., ASMS is the Hall's first comprehensive curriculum program that has been designed from the ground up specifically to meet the vision of the Framework and address the performance expectations of the NGSS. Findings from this study will inform the science education community about how curriculum materials can support NGSS instruction.



Design Features of ASMS

The ASMS curriculum materials aim to provide students in grades 6-8 with opportunities to engage with core ideas and crosscutting concepts in the context of science and engineering practices over time to strengthen their science proficiency. The curriculum package includes a digital platform for students and teachers along with physical materials for hands-on activities.

Designed to enable students to:

- Tackle real-world problems
- Engage with anchor phenomena through multiple modalities
- Interact within a digital workspace with access to custom-written science articles, science simulations, and design tools

Provides teachers with:

- Coherent instructional sequence that builds proficiencies with performance expectations over time
- Explicit support for literacy development
- Support for formative assessment and differentiation
- Online monitoring and reporting tools

Research Questions

Implementation: To what extent is the ASMS curriculum implemented with integrity? What factors (district, school, teacher, and student) are associated with different levels of implementation integrity?

Student Outcomes: What is the impact of the ASMS curriculum on learning outcomes in culturally and linguistically diverse school settings? How does the impact of the ASMS curriculum materials vary by student background characteristics?

Teaching Practice: How does ASMS curriculum support teachers in implementing NGSS instruction? What is the impact on teachers' enactment of instructional practices and classroom activities?

Our Multi-Year Project

We will design and conduct a randomized controlled trial of ASMS in a sample of 7th-grade classrooms comparing ASMS classrooms with those using existing curriculum materials. The study will employ measures of implementation, teaching practice, and student learning outcomes; schools will be randomly assigned to either a treatment or control condition.

3-Phase Research Design

1 Develop and pilot measures of teaching and learning aligned to the NGSS. Piloting includes schools that fully adopted ASMS, but these schools will not serve as sites for the main study.

→ **2** Conduct a random assignment efficacy study in school districts that are new to ASMS and in states that have adopted the NGSS.

→ **3** Analyze and report findings from the efficacy trial. Disseminate to inform NGSS research, practice, policy, and design.

Developing Measures that Align to the NGSS

We are focusing on middle school physical science and life science performance expectations that match our candidate states' standards for 7th grade and that ASMS units provide an opportunity for students to achieve.

We will measure learning outcomes using assessments with multi-component tasks integrating disciplinary core ideas, practices, and crosscutting concepts; we will examine curricular uptake and impact on instructional practice via classroom observations; and we will document teachers' implementation using online instructional logs.

3-Dimensional Assessments

We are using a design process (Harris et al., 2016) that follows the principles of evidence-centered design (Mislevy & Haertel, 2006) to create summative assessment tasks and scoring rubrics. Our two assessments (physical science and life science) are intended to elicit three-dimensional performance.

- Assessments aligned to performance expectations within MS-PS1, MS-LS1, MS-LS2
- 7 task scenarios each for physical science and life science
- Task scenarios contain multiple assessment items that prompt for integrated responses
- Target science practices include: developing and using models, constructing explanations, analyzing and interpreting data
- Target crosscutting concepts include: matter and energy, cause and effect, and patterns
- Scoring rubrics based on evidence statements that integrate multiple dimensions

Instructional Logs

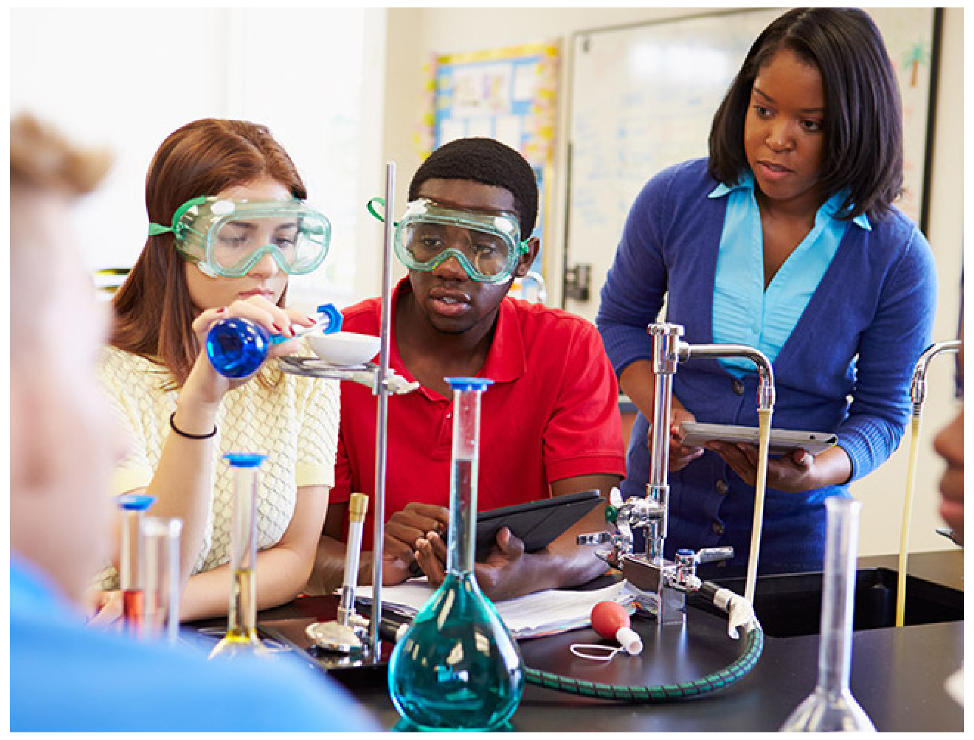
Online instructional logs are a reliable cost-effective way of gathering data on curriculum enactment and instruction across a large number of classrooms and at specific times during implementation (Rowan & Correnti, 2009).

- Teachers self-report on their use of curriculum materials in both conditions
- Enactment questions focus on lessons and activities enacted each week, modifications made and why, and successes and challenges encountered
- Instruction questions focus on frequency and depth of engaging students with the NGSS dimensions, instructional strategies employed, and instructional successes and challenges
- Target of 16 weekly logs per teacher aggregated to describe implementation over time

Classroom Observations

We are developing a protocol, informed by recent NGSS-focused research and reports (e.g., Loper et al., 2017; NRC, 2015), which will enable us to characterize instructional patterns as they relate to curricular uptake and supporting students in building NGSS proficiencies.

- Document teaching moves and the interactional and discourse patterns between teachers and students
- Describe curricular uptake including teachers' use of resources and educative features and students' use of digital platform and hands-on materials
- Characterize integrity to program principles, exposure, and participant responsiveness to lessons and activities
- Capture three-dimensional instructional events
- Identify patterns that indicate the "footprint" of ASMS and differentiate it from other curricula



The Main Study: A Randomized Controlled Trial

Forty-eight schools will be randomly assigned to either implement ASMS materials (treatment condition) or their "business as usual" materials (control condition) in their 7th grade science classrooms.

- All seventh-grade science teachers in each school are expected to participate in the study
- Teachers in both conditions will follow their district science scope and sequence
- Treatment teachers receive the full-year curriculum package + professional development that is commercially available to any district
- Control teachers receive the intervention the following school year (delayed treatment design)
- Mixed methods approach to capture instructional practices in treatment and control classrooms, examine implementation, and estimate the impact of the ASMS curriculum

Benefits to Participating Districts and Teachers

Our approach is to frame benefits in terms of the practical support that we can provide to districts' science programs through their participation. This support includes:

- Full year of 7th grade ASMS curriculum materials with accompanying professional development at no cost
- All teachers receive stipends for participating in the professional development and research activities
- Teachers in control condition receive the curriculum and professional development for the year following the study
- Sample assessment tasks and rubrics available for classroom use after the study concludes

Study Data Sources

Source	Purpose	Administration
Teacher Surveys		
• Teaching Pre-Survey	Establish baseline for teachers' education, certification, and experience; science teaching perspectives and practices; prior professional development support	All teachers prior to the study
• Post-Unit Implementation Survey	Online self-report on overall successes/ challenges in enacting curricular units	All teachers after completing physical and life science instructional sequences
Instructional Logs	Self-report of weekly progress through each target unit	All teachers each week during physical and life science instruction
Observation Protocol	Document implementation integrity and characterize instructional patterns as they relate to curricular uptake and supporting students in building NGSS proficiencies	Sample of treatment teachers during unit implementations
Assessments		
• Physical Science Assessment	Student three-dimensional learning outcomes	All students after completing physical science units
• Life Science Assessment	Student three-dimensional learning outcomes	All students after completing life science units
Interviews	Identify system-level supports and/ or policies needed for effective implementation	Sample of teachers, school principals, and district administrators from each district
System Log Files	Backend data capture of teacher and student online activity	All teachers and students in treatment classrooms

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