Mystery Science Logic Model

Study Type: ESSA Evidence Level IV

Prepared for:
Discovery Education

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March 7, 2024

EXECUTIVE SUMMARY

Discovery Education engaged LearnPlatform by Instructure (LearnPlatform), a third-party edtech research company, to develop a logic model for *Mystery Science*. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).[1]

Logic Model

A logic model provides a program roadmap, detailing program inputs, participants reached, program activities, outputs, and outcomes. LearnPlatform collaborated with Discovery Education to develop and revise the logic model.

Study Design for *Mystery Science* Evaluation

Informed by the logic model, LearnPlatform developed a research plan for a study to meet ESSA Level III requirements. The proposed research questions are as follows:

1. To what extent are students using *Mystery Science* during the 2023–24 school year?
    a. On average, how many minutes will students complete using *Mystery Science* during the 2023–24 school year?
    b. On average, how many lessons will students complete using *Mystery Science* during the 2023–24 school year?
2. To what extent will the average number of *Mystery Science* minutes and lessons that students complete relate to improved performance on local and district assessments, and/or standardized science assessments?
3. To what extent will the average number of *Mystery Science* minutes and lessons that students complete relate to increased participation, engagement, and motivation in science, as self-reported by students or assessed by teachers?

Conclusions

This study satisfies ESSA evidence requirements for Level IV (*Demonstrates a Rationale*). Specifically, this study met the following criteria for Level IV:

✅ Detailed logic model informed by previous, high-quality research
✅ Study planning and design is currently underway for an ESSA Level I, II or III study

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[1] Level IV indicates that an intervention should include a "well-specified logic model that is informed by research or an evaluation that suggests how the intervention is likely to improve relevant outcomes; and an effort to study the effects of the intervention, that will happen as part of the intervention or is underway elsewhere…" (p. 9, U.S. Department of Education, 2016).

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Introduction

Discovery Education engaged LearnPlatform by Instructure (LearnPlatform), a third-party edtech research company, to develop a logic model for *Mystery Science*. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).

The study had the following objectives:

1. Define the *Mystery Science* logic model and foundational research base.
2. Draft an ESSA Level I, II, or III study design.

Previous Research. The design of this logic model was guided by previous research examining the key components of a standards-aligned, phenomena-driven science curriculum that teaches students how to think like scientists. Studies show that hands-on, interactive engagement with problems related to increased student engagement (Mebert et al., 2020) including students' motivation and interest in science (Bell et al., 2009; Reiser et al., 2021). In particular, research shows that students improve their science learning and understanding when they: 1) Construct knowledge through active science learning; 2) connect scientific ideas to real-world problems; 3) experience diverse, scaffolded instruction that meets their unique learning needs; and 4) engage in frequent opportunities for scientific discourse.

Construct knowledge through active science learning. Research shows that active learning strategies improve student learning. Active learning emphasizes engagement, urging students to integrate new concepts with their existing knowledge and experiences (Freeman et al., 2014). Students learn most effectively when actively constructing their understanding (Bransford et al., 1999; Piaget, 1985; Vygotsky, 1978). Within this 'constructivist' framework, instructors play a crucial role as facilitators, nurturing meaningful discussions and stimulating higher-level thinking among students. In contrast, traditional learning approaches rely on the passive transmission of information from instructor to student.

Active learning is also a key element of effective science instruction. A meta-analysis comparing constructivist-centered and exposition-centered (e.g., direct instruction) learning designs in postsecondary STEM (science, technology, engineering, and mathematics) lectures found that students who engaged in constructivist-centered learning had higher assessment outcomes (Freeman et al., 2014). Further, elementary school students who actively participated in technology-enhanced inquiry with explicit instruction, enhanced their scientific understanding (Schellinger et al., 2019).

Connect scientific ideas to real-world problems. Research suggests that problem-based learning in real-world scenarios is important for improving student learning (Mebert et al., 2020). The Next Generation Science Standards (NGSS) (National Research Council, 2012) envisioned a shift in teaching methods and materials to foster more meaningful student engagement in science. This involved promoting scientific understanding from the student's perspective, where learning progresses through collaboratively designed questions and solutions, rather than just textbooks or direct instruction. An example of this is 'Storylines;' an instructional approach that embraces design principles aimed at involving students in exploring scientific phenomena and generating their own inquiries. In this approach, educators guide students through the 'sensemaking' process gradually constructing and refining explanatory models as well as designing solutions (Reiser et al., 2021). Students who learned to connect their lives with the content of their science courses showed increased interest in science and received higher course grades, particularly those who had lower expectations of their own success (Hulleman & Harackiewicz, 2009).

Experience diverse, scaffolded instruction that meets their unique learning needs. Scaffolding refers to an instructional strategy where educators provide supportive actions to students to complete a task (Wood et al., 1976). Scaffolds support learners in problem-based learning by supporting inquiry, helping embed key concepts and ideas, addressing misconceptions, and promoting reflective thinking (Simons & Ertmer, 2005). Scaffolding can help educators meet students' individual learning needs and can support them to better understand scientific phenomena (Schwarz et al., 2009).

The ability of science instruction to meet students' unique learning needs is also enhanced when it is rooted in diverse content and culturally responsive teaching. This refers to instruction that is designed with students' unique lived experiences and cultural backgrounds in mind (Gay, 2018). Studies show that culturally responsive instruction is associated with positive academic outcomes and increased student engagement (Anyichie et al., 2023; Byrd, 2016). Studies show that instructional materials aligned with the NGSS (National Research Council, 2012) and designed with equity in mind, improve learning outcomes for all students, including English learners (Haas et al., 2021).

Engage in frequent opportunities for scientific discourse. Educators who include chances for scientific discourse in their teaching help students grasp scientific concepts better (Colley & Windschitl, 2016; Craddock, 2021; Criswell et al., 2021; Tang, 2020). Successful project-based instruction should be rooted in scientific activities that cultivate investigative skills in real-world contexts as well as foster student collaboration and community building within the classroom (Baumgartner & Zabin, 2008).

In sum, research supports the potential of science instruction to improve student outcomes when it includes active learning; real-world problem solving; meeting students' unique learning needs; and engaging students in meaningful scientific discourse. *Mystery Science* provides a single, 'open-and-go' source for instructional resources for educators grounded on these best practices in science instruction and it has the potential to improve student engagement and curiosity in science–as well as academic outcomes–for all students.

Logic Model

A logic model is a program or product roadmap. It identifies how a program aims to impact learners, translating inputs into measurable activities that lead to expected results. A logic model has five core components: inputs, participants, activities, outputs, and outcomes (see Table 1).

Table 1. Logic model core components

Component	Description	More information
Inputs	What the provider invests	What resources are invested and/or required for the learning solution to function effectively in real schools?
Participants	Who the provider reaches	Who receives the learning solution or intervention? Who are the key users?
Activities	What participants do	What do participants do with the resources identified in Inputs? What are the core/essential components of the learning solution? What is being delivered to help students/teachers achieve the program outcomes identified?
Outputs	Products of activities	What are numeric indicators of activities? (e.g., key performance indicators; allows for examining program implementation)
Outcomes	Short-term, intermediate, long-term	Short-term outcomes are changes in awareness, knowledge, skills, attitudes, and aspirations. Intermediate outcomes are changes in behaviors or actions. Long-term outcomes are ultimate impacts or changes in social, economic, civil or environmental conditions.

LearnPlatform reviewed *Mystery Science* resources, artifacts, and program materials to develop a draft logic model. Discovery Education reviewed the draft and provided revisions during virtual meetings. The final logic model depicted below (Figure 1) reflects these conversations and revisions.

Mystery Science

Logic Model

Problem Statement: It is often challenging for K–5 educators to provide consistent, high-quality science lessons and resources to students due to a lack of time, capacity, or appropriate supports. *Mystery Science* is an 'open-and-go,' standards-aligned, and hands-on curriculum that helps students see how scientific ideas relate to their daily lives. Its phenomena-driven instruction helps kids to apply scientific practices and deepen their understanding of scientific concepts through three-dimensional (3D) learning.[1]

Inputs

What does Mystery Science provide?

MYSTERY SCIENCE PROVIDES
- Online platform with classroom-ready science lessons, hands-on labs, 3D assessments, lesson extensions, and instructional supports for educators
- Anchor Layer Storylines:[2] Phenomena-driven units that connect to the real-world through visuals, discussion, writing, project-based performance tasks, and teacher guides
- Visual vocabulary resource to support all learners and deepen understanding of key science concepts
- Alignment to the Next Generation Science Standards (NGSS) and state standards
- Video based mini-lessons that support student curiosity and answer student questions on a wide range of science-related topics
- Resources to extend lessons with additional videos, readings, activities, and writing
- Team of Mystery Guides (video instructors) from diverse contexts and with unique lived experiences working in science
- All student-facing materials accessible in English and Spanish
- Compatibility with Google Classroom and other LMS's

DISTRICT PROVIDES
- Technology resources (e.g., online applications, physical devices, software)
- Human resources (e.g., full/part time staff, volunteers)
- Financial resources (e.g. funding)
- Material resources (e.g., printer materials, paper, activity supplies[3])
- Dedicated time for educators to become familiar with the program

Participants

Who uses Mystery Science?

- Students in grades K–5
- Educators (incl. teachers and parents/guardians who are homeschooling)

Activities

How are participants using Mystery Science?

EDUCATORS
- Access *Mystery Science* platform
- Access science units, lessons with hands-on labs, and instructional resources intended to guide students through science concepts in a systematic way, e.g.,
    - Select a grade
    - Select a unit
    - Select a lesson
    - Access resources for any lesson (e.g., videos, student objectives, lesson planning supports, standards alignment, discussion prompts, worksheets, pacing guides, recommended classroom supplies, activity previews, vocabulary resources)
    - Select extension activities
    - Access and administer unit level and lesson level 3D assessments and rubrics, to measure student proficiency

STUDENTS
- Complete and utilize *Mystery Science* lessons, activities, assessments, and resources

Outputs

What are the measurable results of implementing Mystery Science?

EDUCATORS
- Number of active minutes
- Number of sessions/logins
- Number and type of units accessed
- Number and type of Anchor Layer Storylines accessed
- Number and type of lessons accessed
- Number of student assessments and lesson extensions accessed

STUDENTS
- Educator feedback on the extent to which lessons, activities, assessments, and resources are completed and utilized by students[4]

Outcomes

What are the expected changes or impacts of using Mystery Science?

SHORT TERM

Educators
- Have access to 'open-and-go,' research-based science lessons and resources to plan instruction and that focus on three-dimensional and phenomena-driven instructional techniques
- Teach the essential science standards for their grade
- Spend less time on lesson preparation and more time on classroom instruction as well as providing timely feedback and facilitation to students
- Are able to use discussion questions as well as lesson level and unit level assessments to evaluate the proficiency of their students at different points in their learning

Students
- Are engaged and motivated through lessons and activities that are inclusive and relevant to their daily lives and personal interests
- Have access to differentiated science instruction that meets their specific needs
- Have access to lessons that allow for opportunities to discuss, solve problems, analyze data, and use models for more active learning opportunities

INTERMEDIATE

Educators
- Increase the rigor of scientific discourse and scientific explanations in the classroom through use of research-based strategies
- Use scaffolded instruction and hands-on-labs to activate learning and achieve the intended learning goals
- Feel more engaged in their classroom instruction through diverse lessons that engage and excite students

Students
- Increase their ability to design and carry out scientific investigations
- Can communicate rich scientific explanations for real world observations, model scientific ideas, and design solutions
- Are celebrated for their effort and feel supported by their educators and peers through shared experiences of science challenges
- Measurably improve their understanding of science content for their grade level

LONG TERM

Educators
- Are more likely to feel professionally supported and validated
- Deepen their own scientific understanding by designing and delivering student-centered, three-dimensional lessons
- Support long lasting improvements in science outcomes for all students
- Increase their capability to meet the unique learning needs of all their students

Students
- Are more interested in post-secondary STEM course-taking and careers
- Are better able to make evidence-based decisions in their personal, professional, social, and civic lives
- Increase self-efficacy and ownership of learning about the value of scientific reasoning, evidence-based thinking, and investigation
- Learn and grow their curiosity of the world around them by applying scientific thinking to experiences and solutions outside of the classroom

[1] Three-dimensional (3D) learning is an approach to science teaching that focuses on disciplinary core ideas, crosscutting concepts, and scientific practices examining phenomena, developed by the National Research Council's framework for new science education standards (National Research Council, 2012).
[2] Anchor Layer Storylines enhance the *Mystery Science* curriculum with anchor phenomena, student-driven inquiry, opportunities for students to develop and revise their ideas throughout the unit, and performance tasks.
[3] Optional Mystery Packs (containing 'open-and-go' science instructional supplies) are available for purchase but they are not necessary to use *Mystery Science*. All lessons on the platform are designed such that any instructional materials needed can be sourced easily from home, schools, neighborhood supermarkets, etc.
[4] Discovery Education (or any other entity) does not collect any student data within the *Mystery Science* platform.

Figure 1. *Mystery Science* Logic Model

Mystery Science Logic Model Components. Discovery Education invests several resources into its *Mystery Science* program, including:

- An online platform with classroom-ready science lessons, hands-on labs, three-dimensional assessments, lesson extensions, and instructional supports for educators;
- Anchor Layer Storylines:[2] Phenomena-driven units that connect to the real-world through visuals, discussion, writing, project-based performance tasks, and teacher guides;
- A visual vocabulary resource to support all learners and deepen understanding of key science concepts;
- Alignment to the Next Generation Science Standards (NGSS) and state standards;
- Video based mini-lessons that support student curiosity and answer student questions on a wide range of science-related topics;
- Resources to extend lessons with additional videos, readings, activities, and writing;
- A team of Mystery Guides (video instructors) from diverse contexts and with unique lived experiences working in science;
- All student-facing materials accessible in English and Spanish; and
- Compatibility with Google Classroom and other LMS's.

Districts would be expected to provide technology resources (e.g., online applications, physical devices, software); human resources (e.g., full/part time staff, volunteers); financial resources (e.g., funding); material resources (e.g., printer materials, paper, activity supplies);[3] and dedicated time for educators to become familiar with the program. Ultimately, *Mystery Science* is intended to reach students in grades 1–5 and educators (including teachers and parents or guardians who are homeschooling).

Using these program resources, participants can engage with *Mystery Science* in the following activities:

Educators:

- Access Mystery Science platform; and
- Access science units, lessons with hands-on labs, and instructional resources intended to guide students through science concepts in a systematic way, e.g.:
    - Select a grade,
    - Select a unit,
    - Select a lesson,

[2] Anchor Layer Storylines enhance the *Mystery Science* curriculum by presenting anchor, scientific phenomena and encourage student-driven inquiry, opportunities for students to develop and revise their ideas throughout the unit, and performance tasks.

[3] Optional Mystery Packs (containing 'open-and-go' science instructional supplies) are available for purchase but they are not necessary to use *Mystery Science*. All lessons on the platform are designed such that any instructional materials needed can be sourced easily from home, schools, neighborhood grocery stores, etc.

    - Access resources for any lesson (e.g., videos, student objectives, lesson planning supports, standards alignment, discussion prompts, worksheets, pacing guides, recommended classroom supplies, activity previews, vocabulary resources),
    - Select extension activities, and
    - Access and administer unit level and lesson level three-dimensional (3D) assessments and rubrics, to measure student proficiency.[4]

Students:
- Complete and utilize *Mystery Science* lessons, activities, student unit assessments, and resources.

Discovery Education can examine the extent to which core *Mystery Science* activities were delivered and participants were reached by examining the following quantifiable outputs:

Educators
- Number of active minutes
- Number of sessions/logins
- Number and type of units accessed
- Number and type of Anchor Layer Storylines accessed
- Number and type of lessons accessed
- Number of student assessments and lesson extensions accessed

Students
- Educator feedback on the extent to which lessons, activities, assessments, and resources are completed and utilized by students[5]

If implementation is successful, based on a review of program outputs, Discovery Education can expect the following short-term outcomes from use of *Mystery Science*.

Educators
Short term, educators will have access to ‘open-and-go,’ research-based science lessons and resources to plan instruction and that focus on three-dimensional and phenomena-driven instructional techniques. They will also teach the essential science standards for their grade. Educators will spend less time on lesson preparation and more time on classroom instruction as well as providing timely feedback and facilitation to students. Finally, they will be able to use discussion questions as well as lesson level and unit level assessments to evaluate the proficiency of their students at different points in their learning.

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[4] Three-dimensional learning is an approach to science teaching that focuses on disciplinary core ideas, crosscutting concepts, and scientific practices examining phenomena, developed by the National Research Council’s framework for new science education standards (National Research Council, 2012).
[5] Discovery Education (or any other entity) does not collect any student data within the *Mystery Science* platform.

In the intermediate term, educators will increase the rigor of scientific discourse and scientific explanations in the classroom through use of research-based strategies. They will use scaffolded instruction and hands-on-labs to activate learning and achieve the intended learning goals. They will also feel more engaged in their classroom instruction through diverse lessons that engage and excite students.

Long term, educators will be more likely to feel professionally supported and validated. They will deepen their own scientific understanding by designing and delivering student-centered, three-dimensional lessons. Finally, they will support long lasting improvements in science outcomes for all students and increase their capability to meet the unique learning needs of all their students.

Students

Short term, students will be engaged and motivated through lessons and activities that are inclusive and relevant to their daily lives and personal interests. They will have access to differentiated science instruction that meets their specific needs. Finally, they will have access to lessons that allow for opportunities to discuss, solve problems, analyze data, and use models for more active learning opportunities.

In the intermediate term, students will increase their ability to design and carry out scientific investigations. They will be able to communicate rich scientific explanations for real world observations, model scientific ideas, and design solutions. Students will be celebrated for their effort and feel supported by their educators and peers through shared experiences of science challenges. Finally, they will measurably improve their understanding of science content for their grade level.

Long term, students will be more interested in post-secondary STEM course-taking and careers. They will be better able to make evidence-based decisions in their personal, professional, social, and civic lives. Students will increase self-efficacy and ownership of learning about the value of scientific reasoning, evidence-based thinking, and investigation. Finally, they will learn and grow their curiosity of the world around them by applying scientific thinking to experiences and solutions outside of the classroom.

Study Design for *Mystery Science* Evaluation

To continue building evidence of effectiveness and to examine the proposed relationships in the logic model, Discovery Education has plans to conduct an evaluation to determine the extent to which *Mystery Science* produces the desired outcomes. Specifically, Discovery Education has plans to begin an ESSA Level III study to answer the following research questions:

1. To what extent are students using *Mystery Science* during the 2023–24 school year?
    a. On average, how many minutes will students complete using *Mystery Science* during the 2023–24 school year?
    b. On average, how many lessons will students complete using *Mystery Science* during the 2023–24 school year?
2. To what extent will the average number of *Mystery Science* minutes and lessons that students complete relate to improved performance on local and district assessments, and/or standardized science assessments?
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Conclusions

This study satisfies ESSA evidence requirements for Level IV (*Demonstrates a Rationale*). Specifically, this study met the following criteria for Level IV:

✅ Detailed logic model informed by previous, high-quality research

✅ Study planning and design is currently underway for an ESSA Level I, II or III study

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