Science Techbook

Logic Model

Study Type: ESSA Evidence Level IV

Prepared for:
Discovery Education

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EXECUTIVE SUMMARY

Discovery Education engaged LearnPlatform by Instructure, a third-party edtech research company, to develop a logic model for *Science Techbook*. LearnPlatform by Instructure 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 by Instructure collaborated with Discovery Education to develop and revise the logic model.

Study Design for *Science Techbook* Evaluation

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

1. To what extent were grade 5 students using *Science Techbook* during the 2023–24 school year?
    a. On average, how many lessons and assignments were completed by students during the 2023–24 school year?
2. To what extent did the average number of *Science Techbook* lessons and assignments that students completed relate to improved performance on standardized science assessments?
    a. How does this compare with students who did not use the product?

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

[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, a third-party edtech research company, to develop a logic model for *Science Techbook*. LearnPlatform by Instructure 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 *Science Techbook* logic model and foundational research base.
2. Draft an ESSA Level I, II, or III study design.

Previous Research. Science education without enough opportunities for hands-on, interactive exploration of scientific concepts and phenomena often fails to engage students and educators. Further, it is less likely to improve students' science learning outcomes (Duschl et al., 2007; Mebert et al., 2020; Reiser et al., 2021).

Research demonstrates that students' science outcomes improve when they are:

1. given access to phenomena-driven curriculum with three-dimensional learning experiences (Mebert et al., 2020; Reiser et al., 2021);[2]
2. lead investigators in the learning process (Lacy et al., 2022; Passmore et al., 2014; Schwarz et al., 2009);
3. motivated and engaged (Hulleman et al., 2009; Kuo, Tuan, & Chin, 2020; Rule & Meyer, 2009); and
4. provided with timely feedback (Bailey & Heritage, 2018; Cauley & McMillan, 2010).

Phenomena-driven curriculum with three-dimensional learning experiences. Student learning increases when they are given opportunities to collaborate, explore freely, and solve real-world problems (Mebert et al., 2020). Instructional models that include three-dimensional learning experiences, where students can participate in sensemaking,[3] can positively impact student learning and outcomes (Reiser et al., 2021). The Next Generation Science Standards' (NGSS) focus on hands-on inquiry of real-world phenomena is more inclusive and benefits students' engagement and science content learning (Tyler et al., 2018). Teachers that understand the shifts in three-dimensional learning create and implement science lessons that have been shown to enhance student learning (Anderson et al., 2018; Fick, 2018).

Students as lead investigators. Through knowledge construction and the implementation of science practices (e.g., scientific argumentation, model-based reasoning, learning progressions), students deepen their understanding of scientific ideas (Lacy et al., 2022; Passmore et al., 2014; Schwarz et al., 2009). When teachers embed this expectation within their lessons, students are

[2] 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).
[3] Sensemaking is a collaborative practice that involves sharing initial ideas with peers about the cause of real-world phenomena and working through any inconsistencies in their shared understanding).

more engaged and active in their learning (e.g., Schwarz, 2009; Sengul, 2021). For example, teachers that embed opportunities for scientific argumentation in their lessons deepen students' understanding of scientific ideas (Colley & Windschilt, 2016; Craddock, 2021).

Motivation and engagement. Student motivation and engagement in science can be nurtured in multiple ways. Students are more motivated and engaged when they can relate science concepts to their lives and interests. For example, Hulleman and his research team (2009) helped students connect what they were learning in science to their lives, leading to increased interest in science and improved course grades. Students are also motivated and engaged in science when they participate in inquiry-based science instruction of real-world phenomena (Kuo et al., 2020). NGSS' scientific-based practices, such as inquiry-based modeling, motivate and engage students because of real-world connections, exciting topics, student-led investigations and explorations, and multimedia use (Rule & Meyer, 2009).

Timely feedback. Formative and summative assessments are invaluable to student success in science. Timely and thorough feedback supports students' ability to self-monitor, self-correct, and set meaningful learning goals. Feedback allows students to take charge of their own learning (Bailey & Heritage, 2018; Cauley & McMillan, 2010). Furthermore, formative assessment data gives teachers an in-depth understanding of their students' learning needs, differentiating instruction as needed (Bartz, 2017; Faber et al., 2018).

Discovery Education's *Science Techbook* incorporates all of the above features in efforts to improve student science learning outcomes. *Science Techbook* is NGSS-aligned and grounded on research that champions phenomena-driven curricula where students can be lead investigators in solving real-world problems by applying effective science practices.

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 by Instructure reviewed Discovery Education resources, artifacts, and program materials to develop a draft logic model for *Science Techbook*. Discovery Education reviewed the draft and provided revisions via email. The final logic model depicted below (Figure 1) reflects these conversations and revisions.

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Problem Statement: Students should be at the center of learning science, which is grounded in building conceptual understanding across an intentional progression of ideas and skills/processes. Science education that does not provide enough opportunities for hands-on, interactive exploration of scientific concepts and phenomena often fails to engage students and educators and is less likely to improve students' science outcomes. *Science Techbook* provides highly engaging, hands-on, rigorous, and research-based lessons and activities, including rich teacher supports and formative/summative assessment opportunities to monitor student learning. These activities connect students to their inner curiosity by placing them at the center of a three-dimensional science learning experience.[1]

Inputs
What we invest:

A standards-based digital textbook that allows educators and students to experience science phenomena through virtual labs and hands-on activities, engaging videos, and leveled reading passages about real-world events or scientific breakthroughs

Professional learning (PL) and ongoing support resources incl. access to Educator Supports Channel[2] and Discovery Educator Network (DEN)[3]

Accessibility features e.g., text to speech, closed captioning, video transcripts and different Lexile levels, authentic Spanish translations, and translation support in 180+ languages

Support via a district communication toolkit, partner success team, and education support teams

Integration with district-wide systems (e.g. LMS, Google, Microsoft, etc)

Participants
Who we reach:

K–12 Students

Educators

Administrators

Activities
What we do:

Students access *Science Techbook* platform

Students access hands-on and online content, resources, and activities within each lesson

Students complete hands-on and online lessons

Students explore STEM career content and STEM project starters that connect them to the real world

Students complete formative and summative assessments to measure science learning and understanding

Educators and administrators access platform usage, outcome, and progress data for students

Educators observe their peers' use of *Science Techbook* to reflect on best practices either directly or through PL conversations

Educators use resources and activities in classroom instruction

Educators assign hands-on and online lessons for the whole group, small groups, or individual students

Educators administer formative and summative assessments

Educators access support resources e.g., professional learning, educator supports, prep materials, and standards alignment information

Educators provide opportunities for students to participate in group discussions to promote scientific discourse and explanations

Educators and administrators participate in site/district-led PL webinars and live events

Educators and administrators participate in school-based professional learning community (PLC) teams[4]

Administrators ensure users have access to and awareness of *Science Techbook* and available training supports (Educators Support Channel, Professional Learning, DEN)

Administrators access, monitor, and drive product usage and engagement with the program on a regular basis

Administrators provide relevant resources, updates, and ongoing support to educators through district collaboration and communication channels (LMS, PLCs, Email, Social, PL)

Administrators embed *Science Techbook* content within district policies and curricula

Outputs
Products of activities:

Number of unique student, educator, and administrators who access *Science Techbook* platform and frequency of access

Number and type of hands-on and online science content, resources, and activities accessed by students and educators

Number and nature of hands-on and online lessons and assessments completed/assigned/administered

Number and type of STEM career content and STEM project starters accessed and used

Nature of feedback provided by students about relevancy and engagement in science concepts

Number and type of usage and outcome data by lesson, student, and school

Frequency of educator peer observations

Number and type of support resources accessed by educators

Frequency of discussion groups established between students and educators

Number and type of professional learning webinars and events attended and completed

Number and nature of PLC teams

Number and nature of communication touchpoints between educators and administrators concerning *Science Techbook* implementation, updates, and professional learning support

The extent to which *Science Techbook* content is embedded within district policies and curricula and its use promoted and encouraged by administrators

Outcomes
What changes or benefits result...

Short-term

Students increase interest in scientific learning

Students increase ability to design and carry out scientific investigations

Students measurably improve understanding of science content for their grade level

Educators encourage student discussion and collaboration

Educators have access to rich data about their students' science learning

Educators increase participation in professional learning opportunities and communities

Educators have access to rigorous, research-based science resources and digital tools that focus on three-dimensional instructional techniques

Administrators promote the use of three-dimensional instruction to improve understanding of scientific ideas

Administrators have more information about students' science learning in their school or district

Intermediate

Students can communicate rich scientific explanations for real world observations, model scientific ideas, and design solutions

Students increase proficiency using science and engineering practices

Educators can provide students with timely feedback and differentiate lessons based on increased awareness of their students' science skills and knowledge

Educators routinely address learner variability and increase differentiated practices and application in their classroom

Educators develop and implement engaging and effective science lessons that incorporate research based strategies to increase the rigor of scientific discourse and scientific explanations in the classroom

Administrators support educator professional growth and prioritize increasing students' science outcomes across their school or district

Administrators direct and allocate resources and supports for science instruction for educators and schools most in need

Long-term

Students are better able to make evidence-based decisions in their personal, professional, social, and civic lives

Students increase self-efficacy and ownership of learning about the value of scientific reasoning, evidence-based thinking, and investigation

Students demonstrate a growth mindset in terms of the skills and practices used to make sense of scientific ideas

Educators increase capability to meet the unique learning needs of all their students

Educators feel professionally supported and are more likely to coach others in science instruction

Educators deepen scientific understanding by designing and delivering student-centered, three-dimensional lessons

Administrators promote and foster a culture of research-based, three-dimensional science learning

Administrators support the development of a scientific growth mindset for students and teachers

Administrators increase their capability to meet the unique learning needs of all students in their school or district

[1] 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).
[2] The Educator Supports Channel is an online platform that provides school and district leaders with resources on how to share best practices for Discovery Education products/services and empower educators through professional learning
[3] Discovery Educator Network (DEN) is a global online community that connects educators to teaching resources, learning opportunities, and professional peer networking.
[4] Professional learning communities (PLCs) are an approach to school improvement where groups of educators and administrators work collaboratively at the school level to improve student outcomes.

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LEARN PLATFORM BY INSTRUCTURE

Figure 1. *Science Techbook* Logic Model

Problem Statement. Students should be at the center of learning science, which is grounded in building conceptual understanding across an intentional progression of ideas and skills/processes. Science education that does not provide enough opportunities for hands-on, interactive exploration of scientific concepts and phenomena often fails to engage students and educators and is less likely to improve students' science outcomes. *Science Techbook* provides highly engaging, rigorous, and research-based lessons and activities, including rich teacher supports and formative/summative assessment opportunities to monitor student learning. These activities connect students to their inner curiosity by placing them at the center of a three-dimensional science learning experience.

Science Techbook Logic Model Components. Discovery Education invests several resources into their program, including:

- A standards-based digital textbook that allows educators and students to experience science phenomena through virtual labs and hands-on activities, engaging videos, and leveled reading passages about real-world events or scientific breakthroughs;
- Professional learning (PL) and ongoing support resources incl. access to Educator Supports Channel[4] and Discovery Educator Network (DEN);[5]
- Accessibility features e.g., text to speech, closed captioning, video transcripts and different Lexile levels, authentic Spanish translations, and translation support in more than 180 languages;
- Support via a district communication toolkit, partner success team, and education support teams; and
- Integration with district wide systems (e.g. LMS, Google, Microsoft, etc).

Ultimately, *Science Techbook* aims to reach K–12 students, educators, and administrators. Using these product resources, the aforementioned participants can engage with *Science Techbook* in the following activities:

Students:

- Access *Science Techbook* platform;
- Access hands-on and online content, resources, and activities within each lesson;
- Complete hands-on and online lessons;
- Explore STEM career content and STEM project starters that connect them to the real world; and
- Complete formative and summative assessments to measure science learning and understanding.

[4] The Educator Supports Channel is an online platform that provides school and district leaders with resources on how to share best practices for Discovery Education products/services and empower educators through professional learning

[5] Discovery Educator Network (DEN) is a global online community that connects educators to teaching resources, learning opportunities, and professional peer networking.

Educators:

- Access platform usage, outcome, and progress data for students;
- Observe their peers' use of *Science Techbook* to reflect on best practices either directly or through PL conversations;
- Use resources and activities in classroom instruction;
- Assign hands-on and online lessons for the whole group, small groups, or individual students;
- Administer formative and summative assessments;
- Access support resources e.g., professional learning, educator supports, prep materials, and standards alignment information;
- Provide opportunities for students to participate in group discussions to promote scientific discourse and explanations;
- Participate in site/district-led PL webinars and live events; and
- Participate in school-based professional learning community (PLC) teams.[6]

Administrators:

- Access platform usage, outcome, and progress data for students;
- Ensure users have access to and awareness of *Science Techbook* and available training supports (Educators Support Channel, Professional Learning, DEN);
- Access, monitor, and drive product usage and engagement with the program on a regular basis;
- Provide relevant resources, updates, and ongoing support to educators through district collaboration and communication channels (LMS, PLCs, Email, Social, PL);
- Embed *Science Techbook* content within district policies and curricula;
- Participate in site/district-led PL webinars and live events; and
- Participate in school-based PLC teams.

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

- Number of unique student, educator, and administrators who access *Science Techbook* platform and frequency of access
- Number and type of hands-on and online science content, resources, and activities accessed by students and educators
- Number and nature of hands-on and online lessons and assessments completed/assigned/administered
- Number and type of STEM career content and STEM project starters accessed and used
- Nature of feedback provided by students about relevancy and engagement in science concepts
- Number and type of usage and outcome data by lesson, student, and school

[6] Professional learning communities (PLCs) are an approach to school improvement where groups of educators and administrators work collaboratively at the school level to improve student outcomes.

- Frequency of educator peer observations
- Number and type of support resources accessed by educators
- Frequency of discussion groups established between students and educators
- Number and type of professional learning webinars and events attended and completed
- Number and nature of PLC teams
- Number and nature of communication touchpoints between educators and administrators concerning *Science Techbook* implementation, updates, and professional learning support
- The extent to which *Science Techbook* content is embedded within district policies and curricula and its use promoted and encouraged by administrators

If implementation is successful, based on a review of product outputs, Discovery Education can expect the following outcomes.

Students

In the short term, students will increase interest in scientific learning and their ability to design and carry out scientific investigations. In the intermediate term, students will communicate rich scientific explanations for real world observations, model scientific ideas, and design solutions. They will also increase proficiency using science and engineering practices and measurably improve understanding of science content for their grade level. Long term, students will be better able to make evidence-based decisions in their personal, professional, social, and civic lives. They will increase self-efficacy and ownership of learning about the value of scientific reasoning, evidence-based thinking, and investigation. Finally, students will demonstrate a growth mindset in terms of the skills and practices used to make sense of scientific ideas.

Educators

In the short term, educators will encourage student discussion and collaboration. They will have access to rich data about their students' science learning as well as increase participation in professional learning opportunities and communities. Educators will have access to rigorous, research-based science resources and digital tools that focus on three-dimensional instructional techniques. In the intermediate term, educators will provide students with timely feedback and differentiate lessons based on increased awareness of their students' science skills and knowledge. They will address learner variability and increase differentiated practices and application in their classroom. Educators will also develop and implement engaging and effective science lessons that incorporate research-based strategies to increase the rigor of scientific discourse and scientific explanations in the classroom. Long term, educators will increase their capability to meet the unique learning needs of all their students. They will feel professionally supported and be more likely to remain in their role. Finally, educators will deepen scientific understanding by designing and delivering student-centered, three-dimensional lessons.

Administrators

Short term, administrators will promote the use of three-dimensional instruction to improve understanding of scientific ideas and have more information about students' science learning in their school or district. In the intermediate term, administrators will support educator professional

growth and prioritize increasing students' science outcomes across their school or district. They will also direct and allocate resources and support for science instruction for educators and schools most in need. Long term, administrators will promote and foster a culture of research-based, three-dimensional science learning. Finally, they will support the development of a scientific growth mindset for students and teachers and increase their capability to meet the unique learning needs of all students in their school or district.

Study Design for *Science Techbook* 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 *Science Techbook* produces the desired outcomes. Specifically, Discovery Education has plans to begin an ESSA Level II study to answer the following research questions:

1. To what extent were grade 5 students using Science Techbook during the 2023–24 school year?
    a. On average, how many lessons and assignments were completed by students during the 2023–24 school year?
2. To what extent did the average number of Science Techbook lessons and assignments that students completed relate to improved performance on standardized science assessments?
    a. How does this compare with students who did not use the product?

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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