iBlocks Logic Model

Study Type: ESSA Evidence Level IV

Prepared for:
Teq

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EXECUTIVE SUMMARY

Teq engaged LearnPlatform, a third-party edtech research company, to develop a logic model for iBlocks. 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 Teq to develop and revise the logic model.

Research Plan for iBlocks Evaluation

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

1. To what extent did students use iBlocks during the 2022–23 school year?
    - What is the average amount of time that students spend on iBlocks project-based learning modules?
    - On average, how many iBlocks did students complete?
    - On average, how many capstone projects did students complete?
2. Does the average number of iBlocks completed relate to improved understanding of STEM content standards?

Conclusions

This study provides results to satisfy ESSA evidence requirements for Level IV (*Demonstrates a Rationale*).

[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

Teq engaged LearnPlatform, a third-party edtech research company, to develop a logic model for iBlocks. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).[2]

Teq recognizes that students lack opportunities for authentic project-based learning (PBL) experiences that promote transferable skills from the classroom to real-life. This is especially true in STEM-related subject areas because it is challenging for teachers to develop and implement such experiences without meaningful support or resources. iBlocks was designed to support teachers through the development of a topic-specific PBL supplemental curriculum to support student engagement and career readiness.

The study had the following objectives:

1. Define the Teq logic model and foundational research base.
2. Draft an ESSA Level III study design.

Previous Research. Research in Science, Technology, Engineering, and Mathematics (STEM) subjects shows that K-12 students often perceive the content they are learning in class as unrelated to their lived experiences or future aspirations and therefore lose engagement and motivation (Boaler, 2002; Samuelson & Litzler, 2016). Interdisciplinary and transdisciplinary approaches to STEM instruction have shown promise in addressing this issue when compared to more traditional, siloed instructional approaches (Bybee, 2013; English, 2016; U.S. Department of Education, 2014). An interdisciplinary approach, as defined by Vasquez et al. (2013), allows students to deepen their understanding about two or more disciplines by linking the concepts and skills that they learn in each discipline. A transdisciplinary approach focuses on learning the knowledge and skills from two or more disciplines through their application to real problems or projects (English, 2016). Both these integrated approaches to STEM instruction favor connected concepts, which often implies that students are better able to recall knowledge and skills, and also able to transfer these to unfamiliar situations (Honey, Pearson & Schweingruber, 2014). Further, research demonstrates that exposing students to STEM careers and the knowledge about mathematics or science requirements for such careers can enhance their interest in pursuing STEM careers (Blotnicky et al., 2018). Therefore, it is incumbent upon school systems to provide students with opportunities to engage, enjoy, and learn STEM skills and knowledge, so that they can access STEM careers and ensuing economic benefits.

One curricular framework that lends itself to an integrated approach to STEM instruction is PBL. PBL, when applied using authentic STEM problem solving scenarios, can make school-based STEM content relevant and appealing; engage students in learning activities that mirror those of

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actual STEM professionals; and also support the learning of the core (siloed) content (Apedoe & Schunn, 2013; Krajcik & Blumenfeld, 2006). The PBL process also offers opportunities for students to take ownership of their own learning (Chan et al., 2014). Experiential learning, as is promoted in PBL, encourages students to engage in projects by doing and applying knowledge to tackle authentic, real-world problems (Kong, 2020). Research notes that students who engage in experiential learning are better able to make connections across theories and apply the knowledge learned in the classroom to real-world situations (Kolb, 2014). iBlocks' experiential learning and PBL approaches are designed to enable teachers to create a collaborative learning space for students to establish mastery of the subject area(s) while gaining experience that will assist with the development of future-ready skills.

The iBlock activities draw on the Engineering Design Principles (EDP) framework, which focuses on a set of steps associated with engineering concepts such as researching, constructing, testing, and evaluating outcomes to solve complex problems (Lin et al., 2021). This process promotes open-ended problem solving and encourages students to create innovative solutions as they work through each project. Each sequence of lessons within an iBlock also draws on the Universal Design for Learning (UDL) guidelines to ensure all students are engaged in intentional learning that promotes the development of skills that can be useful in future careers. The UDL framework when applied to STEM supplementary curricular materials ensures that all learners can access the content and meaningfully participate in class, group activities, and other learning opportunities through: engagement, representation, and action and expression (Hall et al., 2012). Using a combination of the EDP and UDL frameworks provides a holistic approach to teaching that is adaptable to different student learning preferences, ensuring equitable student achievement (Chita-Tegmark et al., 2012). For every iBlock, students not only complete lessons and ongoing self-assessments but also produce a capstone project (individually or in small group settings) to apply STEM content they have learned over the course of the iBlock. Therefore, offering students the opportunity to demonstrate mastery of learning through a variety of ways.

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).

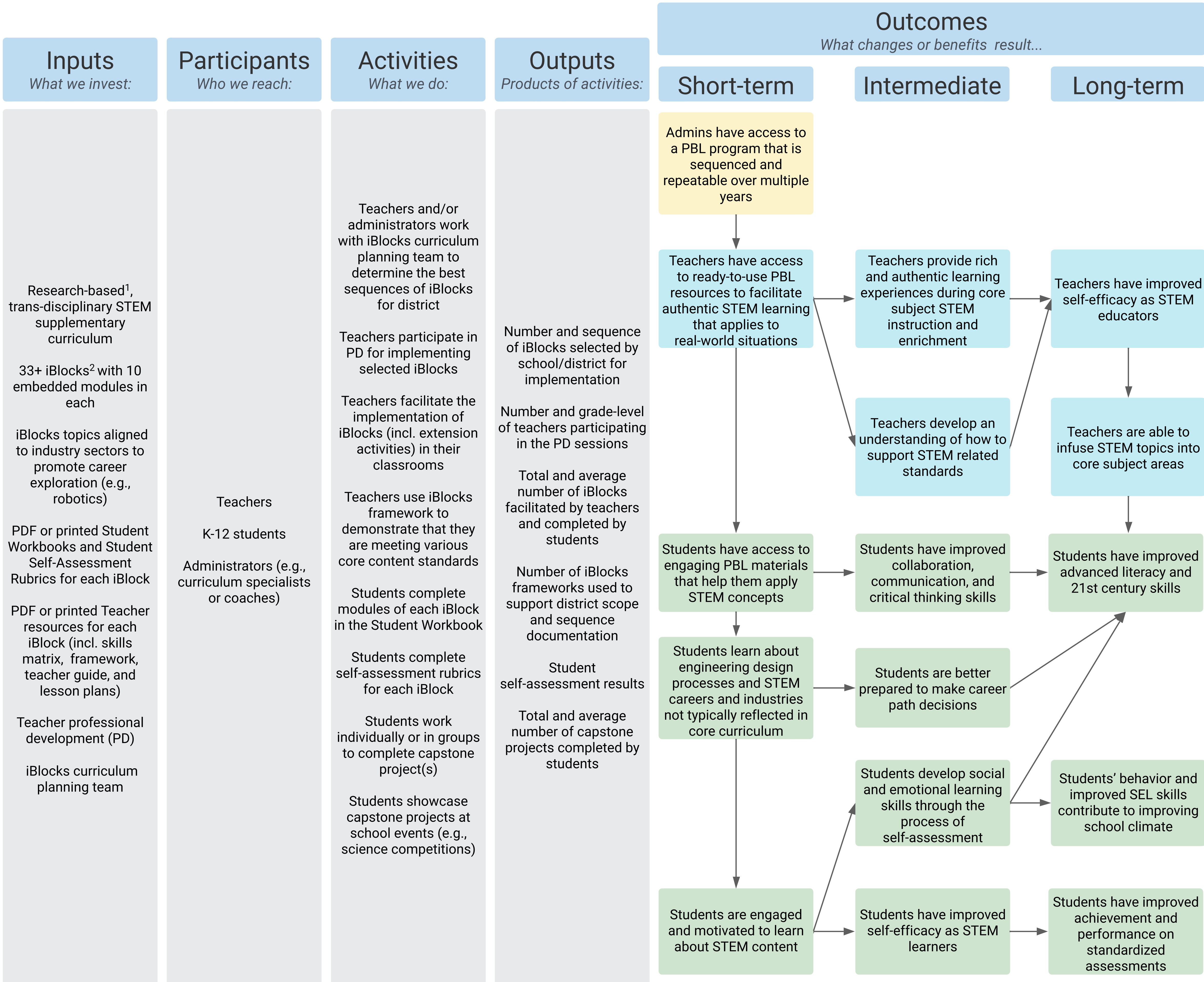
Table 1. Logic model core components

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

iBlocks™ Project-Based Learning

Problem Statement: Students lack opportunities for authentic project-based learning (PBL) experiences that promote transferable skills from the classroom to real-life. This is especially true in STEM-related subject areas because it is challenging for teachers to develop and implement such experiences without meaningful support or resources. iBlocks was designed to support teachers through the development of a topic-specific PBL curriculum to support student engagement and career readiness.



[1] Frameworks/Models include Engineering Design Process, Universal Design Framework, Common Core Standards, NGSS Standards, and UN Sustainability Goals
[2] iBlocks are experiential PBL activities

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Figure 1. iBlocks logic model

iBlocks Logic Model Components. Teq invests several resources into their program, including a research-based[3], trans-disciplinary STEM supplementary curriculum; 33+ iBlocks[4] with ten embedded modules in each; iBlocks topics that are aligned to industry sectors to promote career exploration (e.g., robotics); PDF or printed Student Workbooks and Student Self-Assessment Rubrics for each iBlock; PDF or printed Teacher resources for each iBlock (including skills matrix, framework, teacher guide, and lesson plans); teacher professional development (PD); and access to an iBlocks curriculum planning team. Ultimately, iBlocks aims to reach teachers, K-12 students, and administrators (e.g., curriculum specialists or coaches).

Using these program resources, the following participants can engage with the iBlocks platform in the following activities:

- **Teachers** and/or **administrators** work with iBlocks curriculum planning team to determine the best sequences of iBlocks for the district/school.
- **Teachers:**
    - participate in PD for implementing selected iBlocks,
    - facilitate the implementation of iBlocks (incl. extension activities) in their classrooms, and
    - use iBlocks framework to demonstrate that they are meeting various core content standards.
- **Students:**
    - complete modules of each iBlock in the Student Workbook,
    - complete self-assessment rubrics for each iBlock,
    - work individually or in groups to complete capstone project(s), and
    - showcase capstone projects at school events (e.g., science competitions).

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

- number and sequence of iBlocks selected by school/district for implementation,
- number and grade-level of teachers participating in the PD sessions,
- total and average number of iBlocks facilitated by teachers and completed by students
- number of iBlocks frameworks used to support district scope and sequence documentation,
- student self-assessment results, and
- total and average number of capstone projects completed by students.

If implementation is successful, based on a review of program outputs, in the short term, administrators have access to a PBL program that is sequenced and repeatable over multiple years and teachers have access to ready-to-use PBL resources to facilitate authentic STEM learning that applies to real-world situations. Using this supplementary curriculum, in the intermediate term, teachers are able to provide rich and authentic learning experiences during

[3] Frameworks/Models include Engineering Design Process, Universal Design Framework, Common Core Standards, NGSS Standards, and UN Sustainability Goals

[4] iBlocks are experiential project-based learning activities

core subject STEM instruction and enrichment. Furthermore, teachers are able to develop their own understanding of how to support STEM related standards. In the longer term, teachers have improved self-efficacy as STEM educators and are able to deliver instruction on STEM topics within core subject areas.

In the short term, students have access to engaging PBL materials that help them apply STEM concepts. In the intermediate term, this allows students to develop improved collaboration, communication, and critical thinking skills resulting in improved advanced literacy and 21st century skills in the longer term. Additionally, students learn about engineering design processes, STEM careers, and industries that are typically not reflected in core curriculum in the shorter term. Which implies that in the intermediate term, students are better prepared to make career path decisions. Students are also engaged and motivated to learn STEM content in the shorter term, which translates to them developing social and emotional learning skills through the process of self-assessment, and have improved self-efficacy as STEM learners in the intermediate term. In the longer term, students' behavior and improved SEL skills contribute to improving school climate and improved achievement and performance on standardized assessments.

Study Design for iBlocks Evaluation

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

1. To what extent did students use Blocks during the 2022–23 school year?
    - What is the average amount of time that students spend on iBlocks project-based learning modules?
    - On average, how many iBlocks did students complete?
    - On average, how many capstone projects did students complete?
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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 III study

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