

Intellivance Logic Model

Study Type: ESSA Evidence Level IV

Prepared for:
Intellivance

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EXECUTIVE SUMMARY

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

Logic Model

A logic model provides a program roadmap, detailing program inputs, participants reached, program activities, outputs, and outcomes. LearnPlatform collaborated with Intellivance to develop and revise the logic model (Figure 1).

Research Plan for Intellivance 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 Intellivance during the 2022–23 school year?
 - What is the average amount of time that students spent on Intellivance games (i.e., cards and kits)?
 - On average, how many number facts or patterns do students use to solve Intellivance problem sets?
 - On average, across how many different Intellivance problem sets, are students able to use number facts or patterns?
2. Does the average amount of time that students spend on Intellivance games relate to improved understanding of prime and composite numbers?

Conclusions

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

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Introduction

Intellivance engaged LearnPlatform, a third-party edtech research company, to develop a logic model for Intellivance. LearnPlatform designed the logic model to satisfy Level IV requirements (*Demonstrates a Rationale*) according to the Every Student Succeeds Act (ESSA).¹

Intellivance recognizes that school-based math curricula is often taught in a traditional manner that is not accessible nor engaging for all students. This may result in students feeling inadequate in their academic abilities or becoming unsuccessful in school.

The study had the following objectives:

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

Previous Research. There is a focus on rote memorization and timed-activities in school-based math instruction that excludes many learners from developing a strong foundational understanding of and relationship among numbers (Boaler, Williams, & Confer, 2015). Such instructional approaches often do not meet the needs of all students and result in them feeling inadequate in their academic abilities or becoming unsuccessful in school over time. Students with learning disabilities and those who struggle with mathematics often need specific educational practices that will enable them to succeed at school-based instruction (Kroesbergen & Van Luit, 2003; Fuchs et al. 2021). Therefore, designers of educational learning solutions must align with the specific needs of the intended audience, as they design the affordances of their solutions. The Educational Technology Affordance-Ability Taxonomy, a four-step framework, recommends that developers: “(a) define user needs, (b) identify a potentially useful technology, (c) understand what abilities the technology affords its users and (d) determine what direct and indirect affordances the technology provides relative to the specific needs of the target user group” (Antonenko, Dawson, & Sahay, 2017, p. 916). The Intellivance team has designed features within their system to meet the specific needs of students with learning disabilities as well as those struggling with mathematics.

Intellivance has compiled a system with embedded mathematics problems that address topics, such as prime and composite numbers, by using visual elements to provide all students with relatable, engaging, and multi-representational ways to learn about number sense. The Intellivance PrimeSense™ system also draws on the cognitive theories of multimedia learning (CTML), which suggests that signals or cues in learning materials in the form of colors, arrows in pictures, summaries, headings, or outlines promotes the learning process (Mayer, 2014; Schneider et al., 2018). Further, some studies found that color coding increases retention and transfer of skills because students are able to efficiently locate corresponding information between

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).

illustration and text to attract the learners' attention to perceptually salient information (Ozcelik, Karakus, Kursun, & Cagiltay, 2009).

Intellivance recognizes the value of collaboration and discourse around mathematical concepts. Therefore, they chose not to utilize the typical quiz-based practice drills because research shows that in order for game-playing to have impacts on 21st century skills, games must employ "multiple game-design elements, with collaboration, role playing, narrative, exploration, and complexity" (Qian & Clark, 2016, p. 56). Furthermore, games that present content in a quiz format do not engage learners (e.g., Lester et al., 2014; Ruggiero & Watson, 2014).

Finally, Intellivance PrimeSense™ was designed to be employed as a supplement to the core curriculum or as an after-school activity, enabling a whole-school approach. Results from a study suggest that a whole-school approach that enhances students' engagement during typical math instruction as well as during after school activities may be necessary to raise students' mathematics achievement (Fung, F., Tan, C. Y., & Chen, 2018).

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	<p>Short-term outcomes are changes in awareness, knowledge, skills, attitudes, and aspirations.</p> <p>Intermediate outcomes are changes in behaviors or actions.</p> <p>Long-term outcomes are ultimate impacts or changes in social, economic, civil or environmental conditions.</p>

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

Intellivance Logic Model Components. Intellivance invests several resources into their system, including Intellivance's PrimeSense™ system of mnemonic symbols based in factor mathematics; a multi-disciplinary and -sensory learning language (math and music elements); games, playgrounds, kits, and cards based on PrimeSense™; visual symbol system for inclusive teaching practices (e.g., visual and physical impairments); facilitator resources and workshops including activity guides for games; and customizable features (e.g., decals, mats).

Ultimately, the Intellivance program aims to reach K-5 students and educators (including classroom teachers, extra-curricular instructors, after-school caretakers, parents, homeschooling parents). Using these program resources, students and educators can engage with the Intellivance PrimeSense™ game kits via the following activities:

- Students:

- interact with visual, auditory, and/or tactile elements of games/activities;
- experience numerical patterns in a wide range of physical applications (e.g., multiplication as scaling or an area model);
- engage, play, and socialize with peers around the elements of the games; and
- solve math problems underpinning the games.
- Educators facilitate individual or group-based activities based on games, kits, and cards.

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

- average amount of time spent on games, overall
- number and nature of games(s) played by students
- number of problems solved by students
- number of exposures to a single game
- time spent on each game

Problem Statement: School-based math curricula is often taught in a traditional manner that is not accessible nor engaging for all students. This may result in students feeling inadequate in their academic abilities or becoming unsuccessful in school.

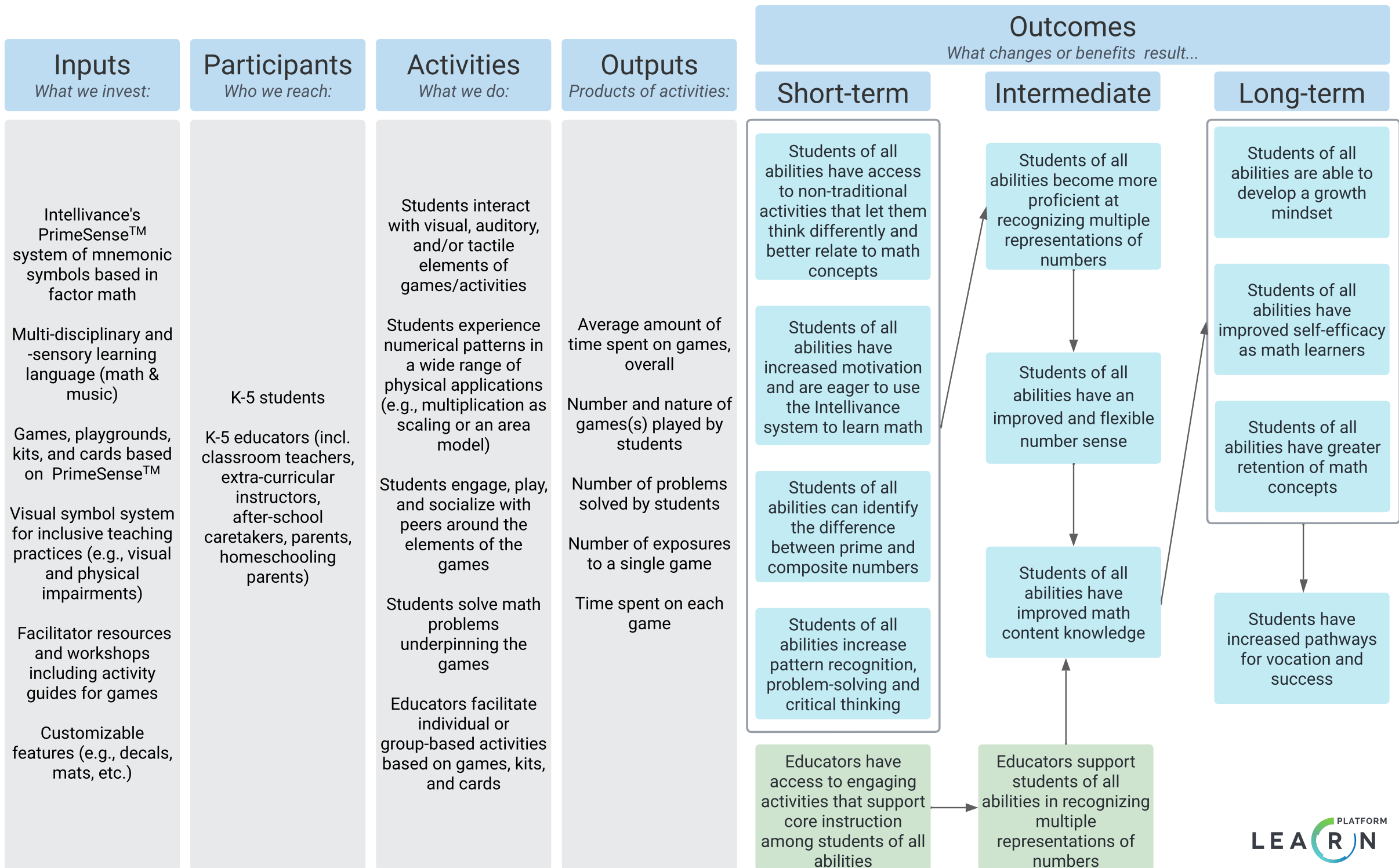


Figure 1. Intellivance logic model

If implementation is successful, based on a review of program outputs, Intellivance can expect the following short-term outcomes. Students of all abilities have access to non-traditional activities that let them think differently and better relate to math concepts. Moreover, students have increased motivation and are eager to use the Intellivance system to learn math. As students engage with the games, they are also able to identify the difference between prime and composite numbers and increase pattern recognition, problem-solving and critical thinking skills. Meanwhile, educators have access to engaging activities that support core instruction among students of all abilities in the short term.

In the intermediate term, the collection of short term student outcomes will result in students of all abilities becoming more proficient at recognizing multiple representations of numbers, have an improved and flexible number sense, and have improved math content knowledge. Educators in the intermediate term are able to support students of all abilities in recognizing multiple representations of numbers and therefore also contribute to students' improved math content knowledge. In the longer term, students of all abilities are able to develop a growth mindset, have improved self-efficacy as math learners, have greater retention of math concepts, and thus have increased pathways for vocation and success.

Study Design for Intellivance Evaluation

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

1. To what extent did students use Intellivance during the 2022–23 school year?
 - What is the average amount of time that students spent on Intellivance games (i.e., cards and kits)?
 - On average, how many number facts or patterns do students use to solve Intellivance problem sets?
 - On average, across how many different Intellivance problem sets, are students able to use number facts or patterns?
2. Does the average amount of time that students spend on Intellivance games relate to improved understanding of prime and composite numbers?

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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