Chapter 3
Logic Models as a Framework for Iterative User Research in Educational Technology: Illustrative Cases

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ABSTRACT

Educational technology development is a design problem. Product developers must optimize between what educational research suggests would be most effective, technological or other software development constraints, and the practical needs of end users and key stakeholders. Creating a logic model and using it to guide a user research program can help product developers tackle this problem. A logic model is a structured description of how a specific product achieves an intended learning outcome. Developing a logic model helps product developers make explicit their assumptions about users, product features, and use cases. Then a user research program can be constructed to test each of these assumptions and provide actionable feedback for further iterations of the product. In this chapter, we present three cases that highlight how the logic model approach can guide a program of research, and how that research has led to tangible product improvements.

INTRODUCTION

Educational technology development is a complex design problem. Product developers must optimize between what educational research suggests would be most effective, technological constraints, and the practical needs of the end user. In addition, educational technology operates within a complex ecosystem that contains multiple types of users and stakeholders (i.e., students, teachers, administrators, and parents), different physical learning environments, and different expectations for different use cases (e.g.,

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a curriculum product that aims to improve scores on high-stakes standardized tests vs. an educational game that children play outside of the classroom).

WestEd has partnered with over 50 educational technology companies to conduct iterative user research for products at different stages of development. These products include educational games, student-facing instruction, and teacher tools. User research at WestEd is a collaborative, interdisciplinary process that brings experts in academic content, teaching, learning sciences, and human-computer interaction together with the product developers. Developing an effective educational technology product requires an understanding of all these fields.

To tackle the educational technology design problem, we adopt a specific iterative user research approach that is centered around a product's logic model. A logic model is a structured description of how a specific product achieves an intended learning outcome. The focus of the logic model is on precisely describing the mechanism behind the product's effects. The use of logic models is common in academic research and program evaluation, but is less common in technology product development. Table 1 shows an example of a logic model for a fictional educational game in mathematics.

WestEd's approach to logic models is a variant on the five-column logic format that describes the inputs, activities, outputs, outcomes, and impacts of a program (W.K. Kellogg Foundation, 2004).

1. **Inputs:** Are assumptions about the product's users and functionality.
2. **Activities:** Describe user interactions with the product in very specific terms.
3. **Outputs:** Describe the immediately observable effects of using the product as intended. These are often metrics that are gathered from within the product itself (e.g., usage logs).
4. **Outcomes and Impacts:** Respectively describe the short-term and long-term learning and behavior changes that occur after using the product. These are typically measured using surveys and assessments external to the product.

Logic models are read as a series of conditionals. If the inputs exist, then the activities can occur. If the activities occur, then the outputs should occur, and so on.

The logic model is a living document that evolves with the product's design. At each stage of product development, the logic model represents the development team's current understanding of the product's target users, intended features, and how the product should be used to produce the desired learning outcomes.

Logic models are related to, but not interchangeable with, program theories or theories of change. Theories of change provide a high-level view of how and why a program or product will achieve a goal

Table 1. An example of a logic model for a fictional educational game in mathematics

Inputs	Activities	Outputs	Outcomes	Impacts
• Socioeconomically disadvantaged students ages 10-12 • Game provides opportunities to explore math operations in non-threatening environment • Game provides immediate feedback on student moves	• Students play game independently at home for at least 10 minutes, 3 times a week, for four months • Students encode feedback from game	• Students reorganize mathematics knowledge • Students experience enjoyment during game-play	• Students adopt positive attitudes and increased confidence in mathematics • Students exhibit improved scores on tests of mathematical problem solving	Students exhibit improved grades and retention in mathematics