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Technical Evaluation Assistance in Mathematics & Science

Identifying Measures for Evaluating Changes in Teacher Practice, Teacher and Student Attitudes and Beliefs, and Sustainability

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Technical Evaluation Assistance in Mathematics & Science

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Technical Evaluation Assistance in Mathematics & Science

Strengthen the quality of the MSP project evaluation and build the capacity of the evaluators by strengthening their skills related to evaluation design, methodology, analysis, and reporting.

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Today's Objectives

Identify and define a variety of **outcomes** and methods to **measure** those outcomes that projects may wish to use to demonstrate the impacts of the MSP project

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Things to Consider

- Exploratory nature of project vs. explicit nature of the project
- Measures of the logical connections between activities and impacts
  - Proximal vs. distal relationships
- Importance of fidelity measures
- Use existing vs. developing or adapting
  - Document validity and reliability
- Importance of documenting measures and instrument

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Clarification of Terms

- **Measure**—What is to be quantified
  - Teacher beliefs
- **Indicator**—A concise description of how a value will be calculated for a measure
  - Examples
    - Percent of Grade 8 students who met the science standard on the state assessment
    - The teachers' score on the professional culture subscale on the annual teacher survey
- **Instrument**—The tools used to collect data to calculate the measures

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Chicken or the Egg Problem

The Evaluator's Version:

Which came first?

The Instrument

OR

The Measure

Exploratory vs. Explicit Nature of the Project

Does the project have a theory of action?

If so, how explicit is it?

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What Is a Theory of Action

- Collective belief about causal relationships between action and desired impacts
  - Simple:

    If . . . Then . . .
  - Complex:

    If . . . and . . . and . . . and . . .

    Then . . .
- A collaborative interpretation of the literature

Characteristics of an Explicit Theory of Action

- Can be a testable hypothesis
- Useful for defining fidelity of project implementation
- Describes project impact as close to the primary target audience as possible
  - A description of what **students do to learn**
- Recognizable when it is going on
  - Observable
- Believable

Science Example

- Students learn science when they:
  - Articulate their initial ideas,
  - Are intellectually engaged with important science content,
  - Confront their ideas with evidence,
  - Formulate new ideas based on that evidence, and
  - Reflect upon how their ideas have evolved

Math Example (Common Core State Standards)

If teachers use developmentally appropriate yet challenging tasks and activities that engage students in:

- **Justifying**—Explaining and justifying their reasoning mathematically
- **Generalizing**—Identifying and verifying conjectures or predictions about the general case
- **Representing**—Using representations (symbolic, notation, graphs, charts, tables, and diagrams) to communicate and explore mathematical ideas
- **Applying**—Applying mathematical skills and concepts to real-world applications

Then student achievement and interest in mathematics will increase.

Implications for Choosing Measures

Continuum of Project Types

Evaluating exploratory projects that seek to identify relationships between interventions and impacts

- Tend not to have an explicit theory of action
- Require a broad range of measures
- Measures must be general in nature

Evaluating projects with explicit theories of action

- Require fewer measures
- Measures can be more focused

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Measures of the Logical Connections Between Activities and Impacts

AKA: What is in the Black Box?

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Attainment of Goals and Objectives

- A Primary Role of Evaluation
  - To what extent has the project met its stated goals and objectives?
- Goals tend to be expected impacts
  - Student achievement goals
  - Increased enrollment in STEM disciplines
- Objectives tend to be activities or strategies
  - Conduct teacher professional development
  - Provide specific experiences for students

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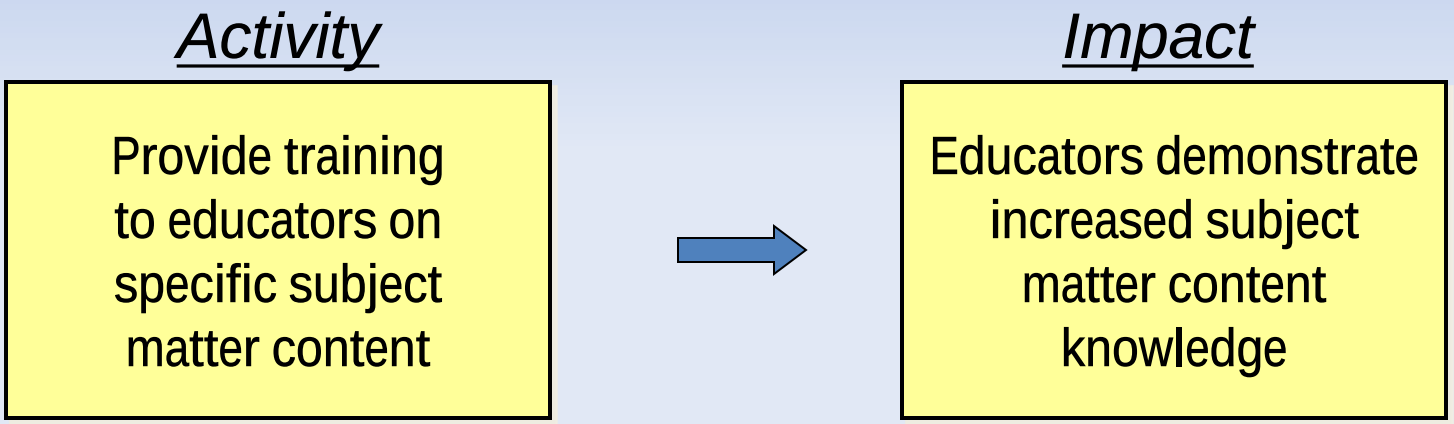
What is Between Activities and Impacts?

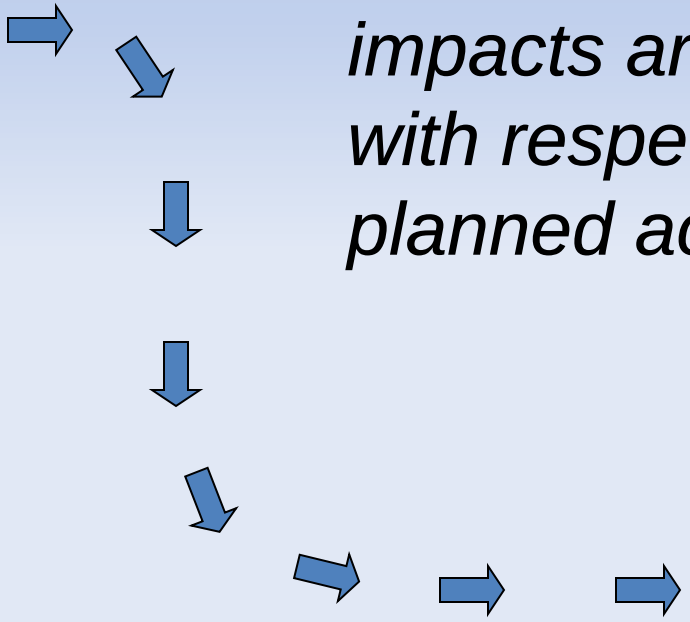
- Example of **proximal** relationship



Example of Distal Relationship

Activity

Provide training to educators on specific subject matter content



For almost all projects in education, the expected impacts are very distal with respect to the planned activities!

Impact

Students increase achievement in the subject matter content

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What We Really Want!

Activity

Provide training to educators on specific subject matter content

Impact

Student increase achievement in the subject matter content

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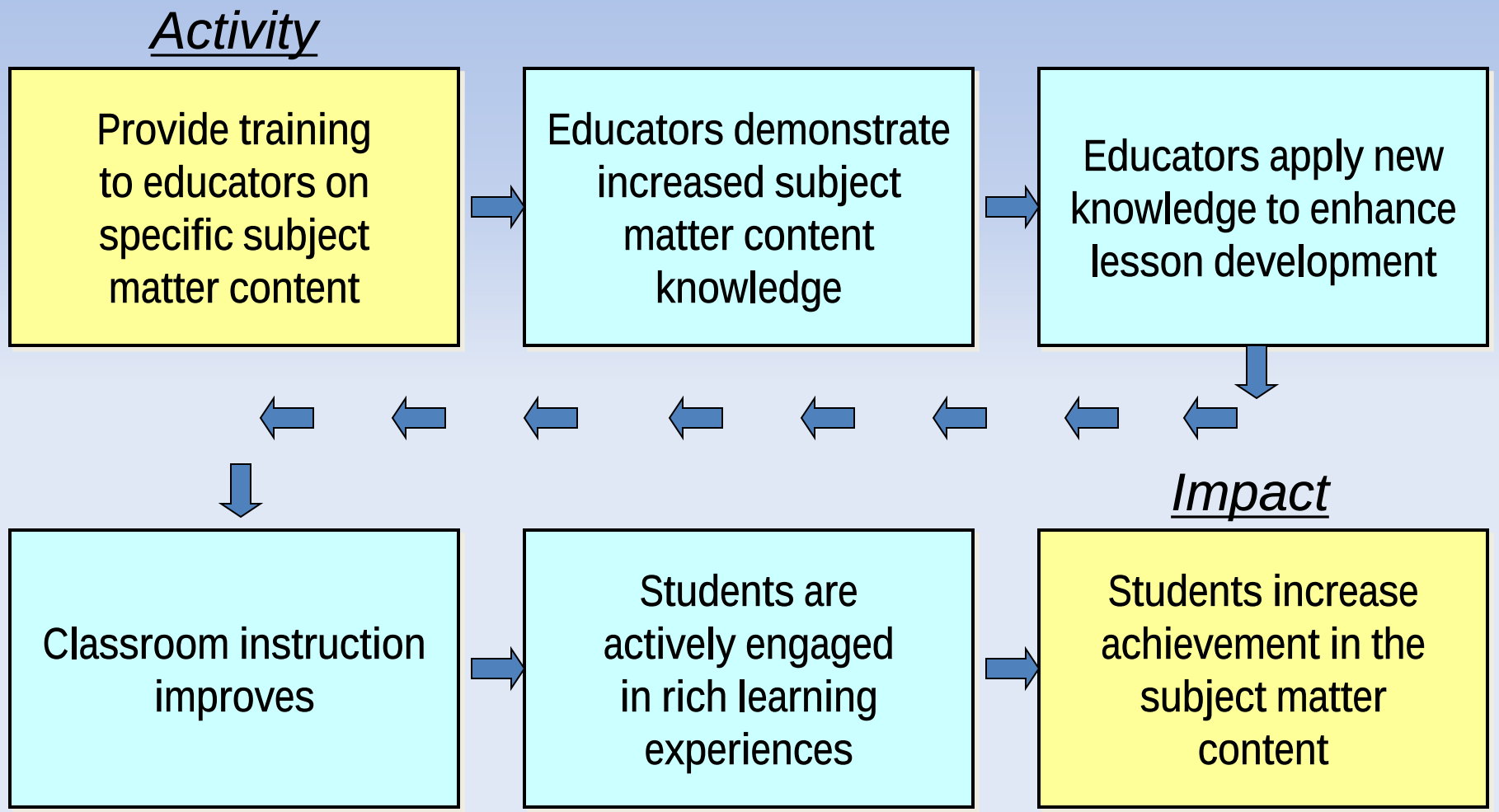
In Reality, A Lot Must Happen



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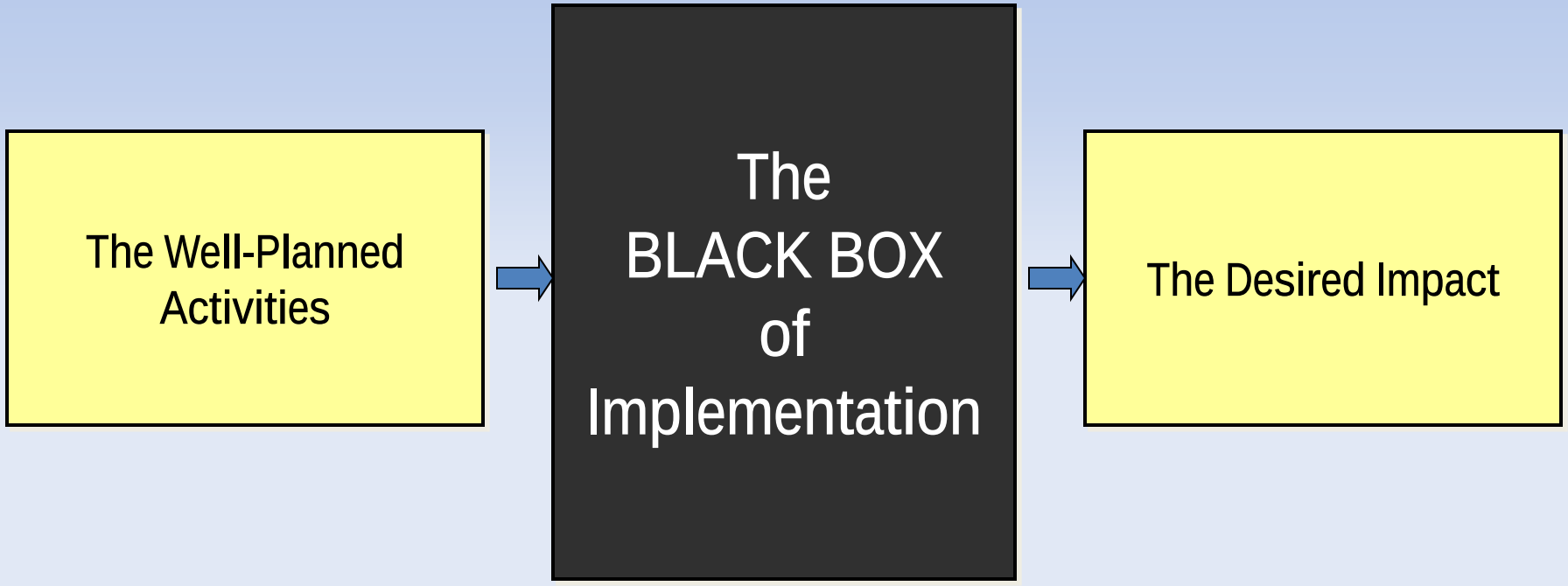
What is Between Activities and Impacts?



Implications for Evaluation

- Evaluation is more complex
- Evaluation is more expensive
- It is more difficult to demonstrate success
- It is more difficult to attribute any success you may find to the intervention

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Implications for Selecting Measures

- The logical connection between activities and impacts should be defined or at least anticipated
- Measures are identified at each step along the way

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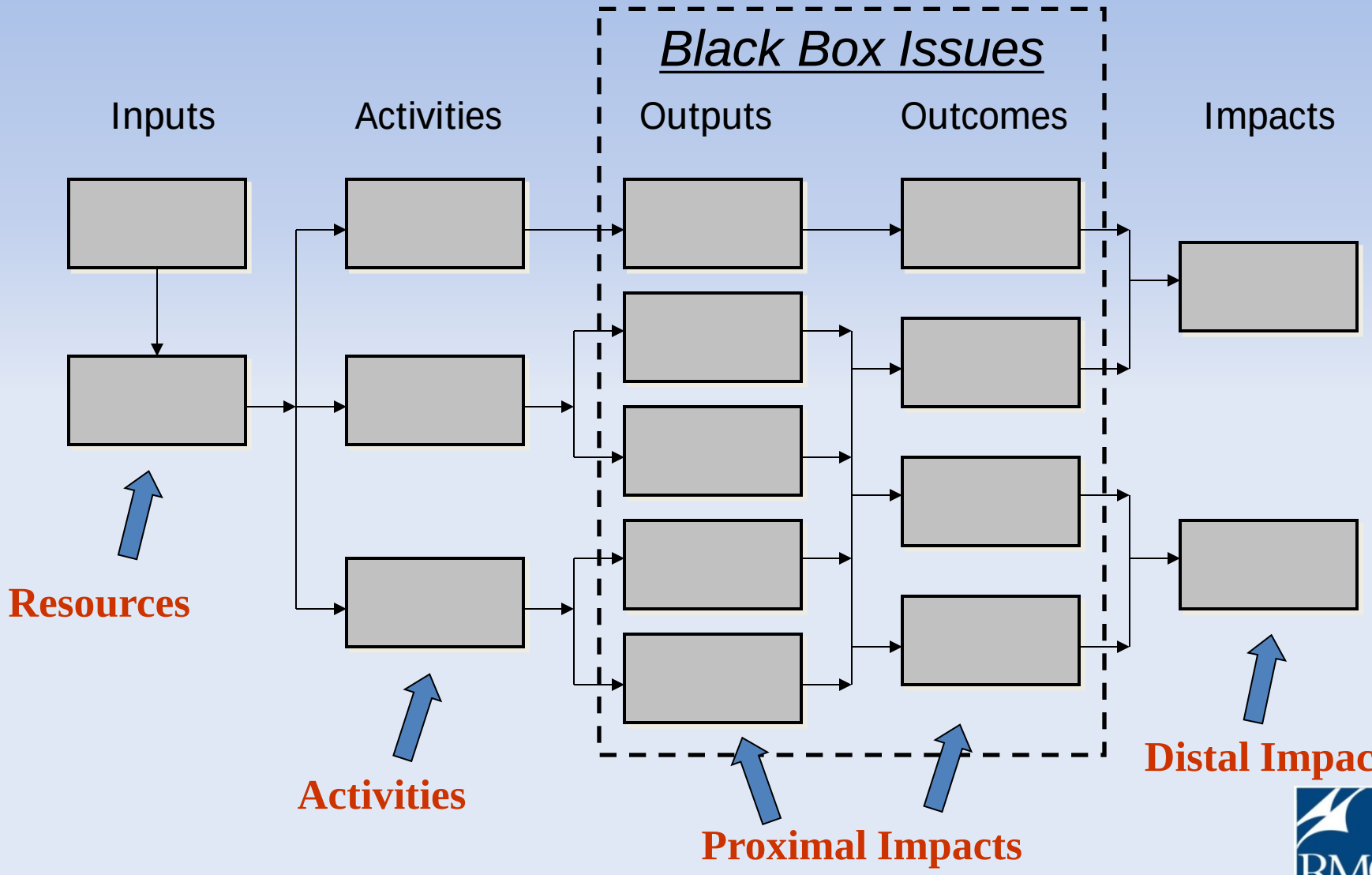
What is a Logic Model

- A diagram that shows the logical connection between project resources, activities, outcomes, and expected impacts
- Incorporates a primary theory of action
- Can be viewed as a collection of theories of actions
- Answers the question:

Why would the planned activities be expected to have the desired impacts?

Basic Logic Model



MSP Example

- Oregon Mathematics Leadership Institute
  - 5-year project funded by NSF
  - 10 School Districts and 86 schools, 2 lead IHEs, Teachers Development Group
- Logic model approach used during the development of the conceptual framework

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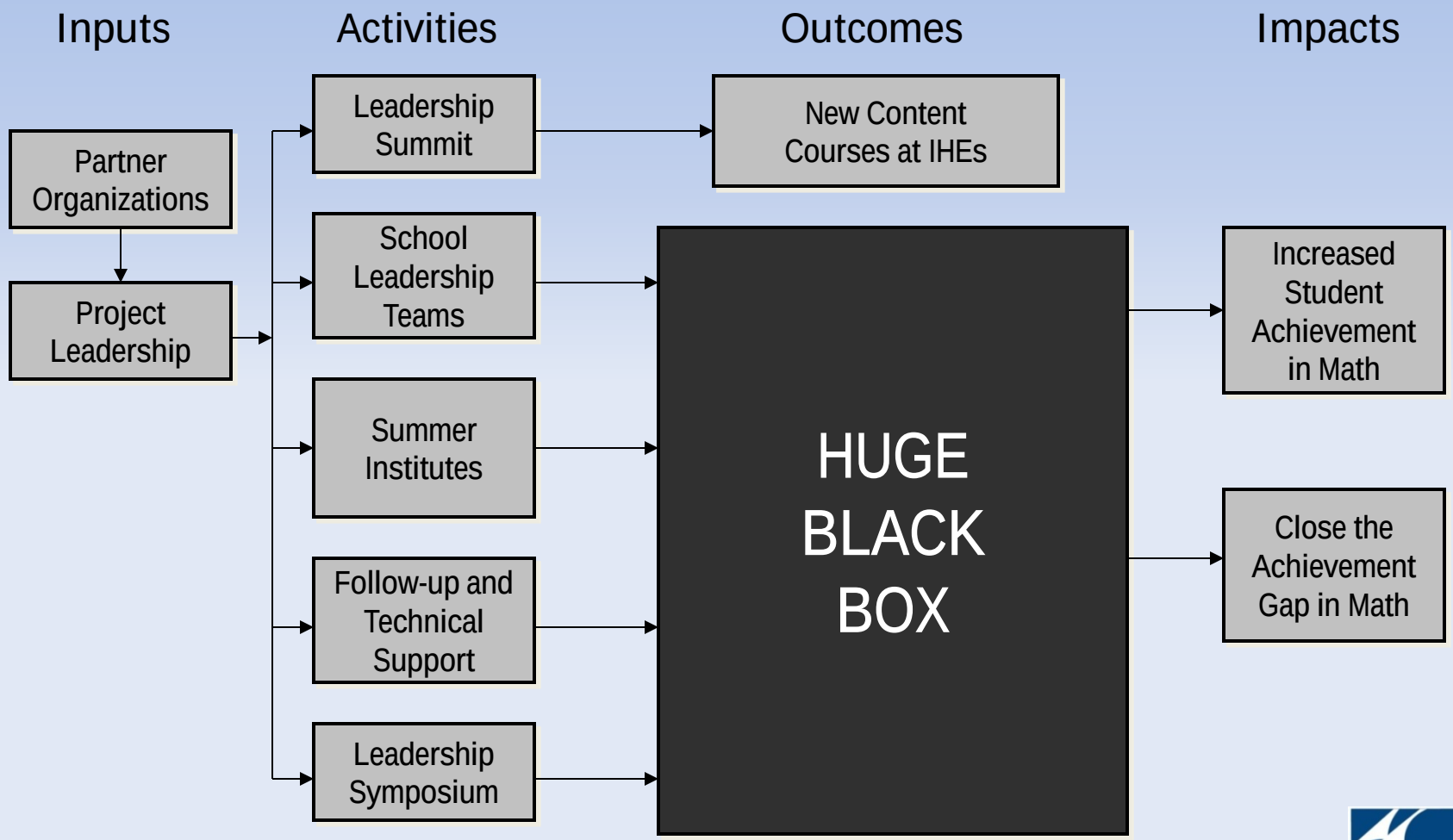
OMLI Example



A Unifying Theme Emerged

- ***If*** *students were more actively engaged in discourse that involves mathematical justification and generalization,* ***then*** *they would develop a deeper understanding of mathematics that would be evident by increased student achievement.*

- This became the **Theory of Action** for the OMLI Project that enabled the leadership to fill in the black box.

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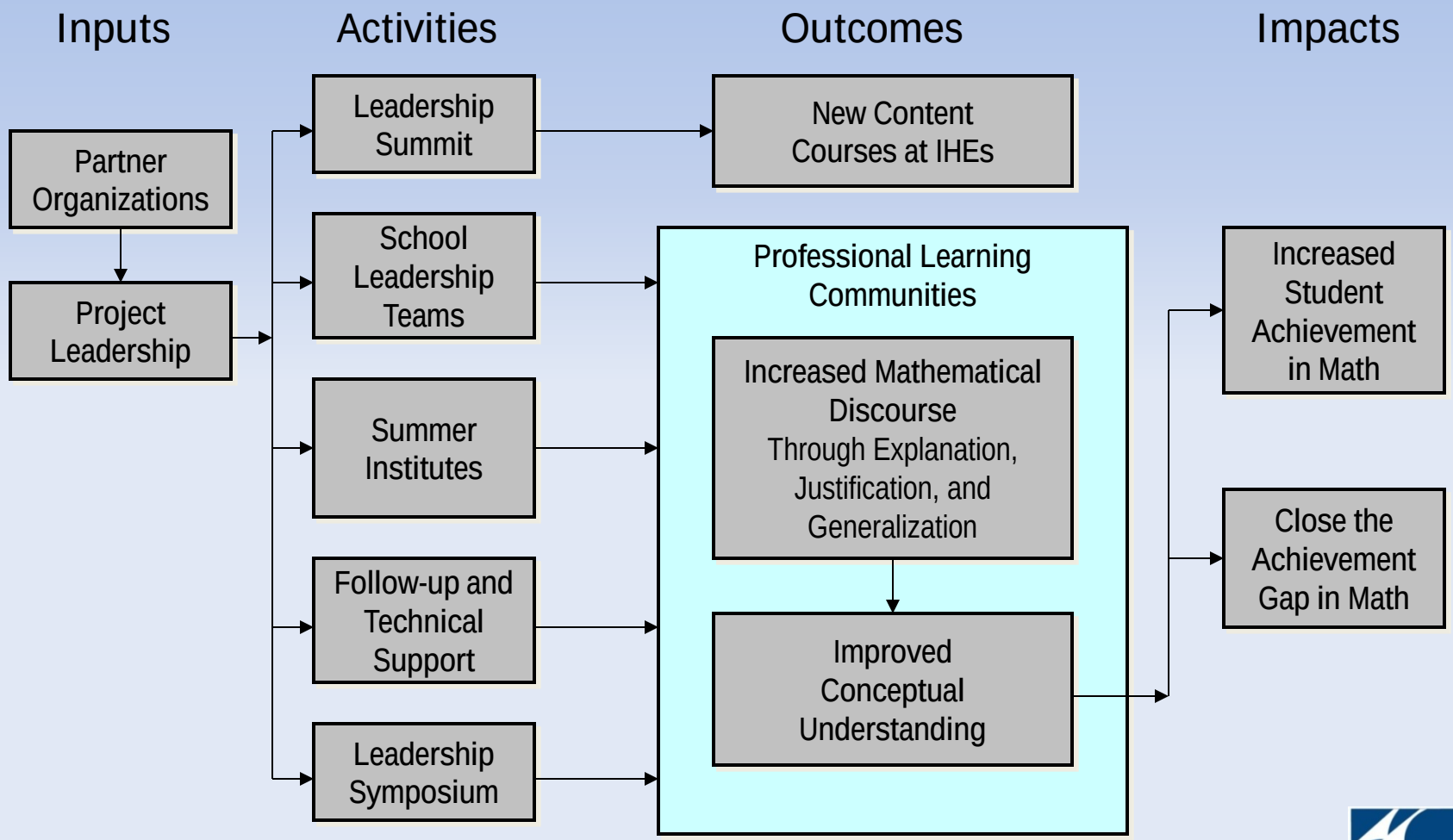
OMLI Example



Using the Logic Model to Identify Measures

- Identify evaluation question for each major component of the logic model
- Identify measures for each component of the logic model
- Develop indicators
- Identify methodology
  - Multiple informants
  - Multiple data collection methods

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Questions!

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Some Common Measures

- Teacher Practice
- Student Engagement
- Teacher and Student Attitudes and Beliefs
- Sustainability
- Teacher Preparedness
- Instructional Leadership
- Administrative Leadership
- Partnership
- Professional Climate
- Fidelity

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Teaching Practice

- **TEACHERS**—Actions a teacher takes to support students learning

Method	Existing Instruments
Observation	Inside the Classroom Observation and Analytic Protocol Reformed Teaching Observation Protocol (RTOP)
Survey	Arizona Mathematics Partnership (AMP) Teacher Survey Surveys of Enacted Curriculum Inside the Classroom Teacher Questionnaire (Math or Science)

- **STUDENTS**—Evidence that students are intellectually engaged—focus on what instruction elicits in students

Method	Existing Instruments
Observation	LASER Science Classroom Observation Protocol (Science) OMLI Classroom Observation Protocol (Math)

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Attitudes and Beliefs

- **TEACHER**—Underlying philosophies that influence teacher practice and day-to-day instructional decisions that teachers make

Method	Existing Instruments
Survey	Inside the Classroom Teacher Questionnaire Surveys of Enacted Curriculum TIMSS-R Teacher Questionnaire (Math and Science) Principles of Scientific Inquiry Teacher Survey
Interview	Teacher Beliefs Inventory

- **STUDENT**—Underlying philosophies that influence student engagement in learning and future aspirations

Method	Existing Instruments
Survey	Attitudes Toward Mathematics Inventory Attitudes Toward Science Inventory (Revised)

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Sustainability

- Institutionalization of factors that will sustain the work of the project beyond current funding
  - Policy changes
  - Administrative support
  - Time and structure for school-based PD
  - Establishment of instructional leadership positions (coaches, TOSAs, mentors)

Sustainability Examples

- **Policies**—Evidence of changes in policies and procedure intended to support continuous improvement
- **Access to Instructional Leadership**—The number of schools where instructional leadership is available to all teachers (established position)
- **Administrator Participation**—The attendance rate at meetings and PD intended for administrators
- **Administrator Beliefs**—Administrator's score on the instructional beliefs scale
  - Compared for change over time
  - Compared with that of teachers

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Other Common Measures

- Teacher Preparedness
  - The degree to which teachers feel prepared to engage students in learning activities that align with the project theory of action
    - LSC Through Teacher Enhancement Questionnaires
- Instructional Leadership
  - The degree to which teacher leaders feel prepared to fulfill their role as instructional leaders responsible for influencing colleagues
    - Examining Mathematical Coaching Teacher Survey

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Other Common Measures

- Administrative Leadership
  - Factors such as administrator awareness and support of the project, engagement in professional development, and interactions with teachers
- Partnership
  - Factors that allow partners to move beyond their own individual institutional needs and engage in the work of the partnership to better meet project goals
    - Education R&D Partnership Tool
- Professional Climate
  - Factors that foster a constructive and supportive professional environment such as trust, collegiality, and collaboration
    - Arizona Mathematics Partnership Teacher Survey

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Questions!

Importance of Fidelity Measures

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Fidelity of Implementation

- Requires clear theory of action
- Fidelity of implementation:
  - The degree to which the initiative is carried out the way it was intended
  - The degree to which the spirit of the theory of action is enacted
  - Recognizing that not everyone will implement the way you planned

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Identifying Essential Elements

- What are the essential elements of implementing the project/initiative that make the logic model valid
- Identifies what can and cannot be adapted
- Takes into account human nature and desire to personalize
- Well-defined essential elements can identify fidelity measures

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Process Example

- A project has a PD model that includes five phases in a cyclic process that PD facilitators are expected to follow
- Evaluation Question:
  - To what extent are the facilitators implementing the proposed PD model with fidelity?
- PD Model Fidelity
  - The number of teacher participants who report that the they experienced and can comment on the value of each of the 5 phases

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Outcome and Fidelity Example

- Theory of Action Includes:
  - Student discourse that involves justifying mathematical reasoning
- Evaluation Questions:
  - To what extent has participation in the project increase student discourse that involves justification of mathematical reasoning?
- Classroom Discourse
  - The percent of classroom observations that indicated the majority of students were engaged in discourse that required them to justify their reasoning mathematically during at least part of the lesson observed

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Advantages of Assessing Fidelity

- Formative Evaluation
  - Provides information to improve the project during implementation
  - Which elements are implemented well?
  - Why are some essential elements difficult to implement?
- Summative Evaluation
  - Did those who implemented with fidelity have better results than those who did not?
- Ensuring Attribution
  - How do you know the things you are measuring are a result of the intervention?
  - Clearly shows a relationship between important elements of the project and the expected outcome

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Use Existing
vs.
Developing or Adapting

- When should I . . .
  - Use existing measures and instruments?
  - Adapt existing measures and instruments?
  - Develop new measures and instruments?

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Using Existing

- Advantages
  - Can take advantage of reliability and validity information provided by others
  - No pilot testing—Ready for use almost immediately
  - Can reveal unanticipated outcomes
- Disadvantages
  - Alignment with project focus
  - Increased burden
- Uses
  - Exploratory

Don't forget . . .

Get appropriate permissions

Give credit

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Adapting Existing

- Advantage
  - Better alignment to project focus
  - Requires less development time than starting from scratch
  - Can be shorter and less burdensome
- Disadvantages
  - May require pilot testing
  - Must test reliability and provide evidence of validity
  - Less likely to reveal unintended outcomes
- Uses
  - Projects with more explicit theory of action

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Developing New

- Advantage
  - Better alignment to project focus
  - Can be shorter and less burdensome
- Disadvantages
  - Requires development time
  - Requires pilot testing
  - Must test reliability and provide evidence of validity
  - Less likely to reveal unintended outcomes
- Uses
  - Projects with more explicit theory of action

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Importance of Documenting Measures and Instrument

Reliability and Validity

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Sharing to Improve Evaluation Rigor

- Wherever possible provide the following information about measures used
  - Complete description of what is measured
  - Target informants
  - Methods for data collection
  - Pilot test procedures
  - Evidence of validity
  - Results of reliability tests
  - Scales and subscales calculations
  - Threshold for missing data

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Review

- Exploratory nature of project vs. explicit nature of the project
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  - Proximal vs. distal relationships
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Resources

- For a copy of this presentation and a document containing the references used to support this presentation, go to:

teams.mspnet.org

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