Cost Analysis for Evaluation in Education

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IMPACT IS NECESSARY BUT NOT SUFFICIENT
Need for Economic Evaluation in Education

• Many interventions, reforms, programs, policies
• Intensively investigate “What Works”
• Very little guidance on
  • “..At What Cost?”
  • “..Is it Worth the Cost?”
Cost-Effectiveness in Education

• The term “cost-effective” has been used frequently over the last 30-40 years in education research

• Very few studies actually examining costs and effects

• Clune Study in late 90’s—

• ERIC had about 10,000 documents with CE as a key word.

• Analysis of a sample of abstracts and papers showed that most were rhetorical claims, “my intervention is cost-effective” with no analysis or evidence or clear meaning; only 2 percent or fewer of papers had credible attempt at CE analysis.
Importance & Effort

- Providing cost information is critical for decisionmaking.
- Costs must be assessed systematically through careful consideration of resource use.
- The ingredients method provides a rigorous approach to assess and examine costs.
Two Primary Tools

- **Cost-Effectiveness**—Comparisons of educational alternatives with same goals to determine which have the largest effects relative to cost.

- **Benefit-Cost**—Comparisons of educational alternatives in terms of costs and monetary value of benefits to see if benefits exceed costs and by how much to inform investment decisions.
Cost Analysis

• Enumerate all resources to implement a policy

• Incremental costs over “next best alternative” or “business-as-usual”

• This is a component of the research and should be guided by research questions and the theory of change
Strapped into the cockpit, she flipped on the switch. The hell-o-cheese-copter sputtered and twitched.

It floated a moment and whirled round and round, then froze for a heartbeat and crashed to the ground.
Figure 1. A Conceptual Framework for Studying Variation in Program Effects, Treatment Contrasts, and Implementation.
Even when costs are offered it may not be an accurate estimate of what is needed to replicate the intervention’s impact.
Example: Read 180

• WWC includes purchase price information - *Incomplete*

• Prescriptive program:
  
  • 90-minutes daily of whole-group, small-group and individualized instruction + videos + feedback

• Class size 15
Cost

As of September 2016, the initial start-up cost of a READ 180® Universal package for 60 students was approximately $43,000. Houghton Mifflin Harcourt provides 2.5 days of in-person professional development with the purchase of the program. A READ 180® Universal upgrade kit for 30 students costs $8,800 and includes teacher materials, 30 Real Books, six boxes of Independent Reading Library books, and access to the new online student application. An upgrade kit with 60 student licenses costs $12,000.
Read 180 Cost Study

- Ingredients Method
- Estimate of costs based on intervention model
- Costs measured from three sites
- Costs based on program design: $1,100 per student
## Read 180 Cost Study

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students served</strong></td>
<td>6,701</td>
<td>1,080</td>
<td>2,400</td>
</tr>
<tr>
<td><strong>Personnel (teachers)</strong></td>
<td>$320</td>
<td>$950</td>
<td>$70</td>
</tr>
<tr>
<td><strong>Personnel (administrators, technicians, coordinators)</strong></td>
<td>$50</td>
<td>$400</td>
<td>$60</td>
</tr>
<tr>
<td><strong>Equipment/materials (computers, licenses)</strong></td>
<td>$250</td>
<td>$150</td>
<td>$140</td>
</tr>
<tr>
<td><strong>Other (prof. dev., sub teachers, other)</strong></td>
<td>$-</td>
<td>$10</td>
<td>$10</td>
</tr>
<tr>
<td><strong>Average Cost</strong></td>
<td>$610</td>
<td>$1,510</td>
<td>$280</td>
</tr>
</tbody>
</table>
Ingredients Method

• Identify resources or ingredients required to obtain a given result (for example, impact in RCT).

• Obtain market prices or equivalents for ingredients.

• Calculate the overall cost and average or marginal cost.

• Determine who pays costs and consequences.

• Relate costs to effectiveness for alternatives.
Notes on the Ingredients Method

- Opportunity Cost Accounting Framework. Any ingredient used has a cost to someone or to society in the value of its best alternative use.

- Volunteers have cost to themselves.

- Resources in kind from other sources have costs.

- Budget are not good sources of costs.
Method in the Field

• Widely accepted.

• Recognized by National Research Council and Institute of Medicine in a recent publication.

• Adopted by JPAL Poverty Lab at MIT for experimental studies.

• Used by World Bank and U.S. Agency for International Development.

• Computer-Based Cost Tool aids in pricing and calculating costs
Costs ≠ Budgets
Problems with Budgets

• Based upon accounting systems developed for what funds were used for—auditing purposes, not costs.

• Cannot do cost-accounting from budget categories.

• Do not consider resources obtained from outside of the budget such as those from other entities or reallocations from other activities.
What type of program are you evaluating?
Basic Options in Education

• New - intervention is unlike anything else being received and is in contrast to no service

• Supplemental - intervention is added onto existing programming or provides supplemental support in addition to standard practice

• Replacement - intervention or approach is intended to replace standard practice
Here, the contrast between treatment and control is clear. The treatment, and associated costs, is incremental to business as usual. The program is an add-on being compared to doing nothing.
Here, the treatment, and associated costs, is an alternative to business as usual. The program replaces current practice.
Here, the contrast between treatment and control is not clear. The treatment may replace some of the practices of BAU but the treatment may also provide more service (resource) than would have been received otherwise.
Figure 6.2. Theoretically expected relative treatment strength and effects. Y = outcome; Tx = treatment condition; C = counterfactual condition.
**Treatment Strength** | **Outcome**
--- | ---
.00 | 50
.10 | 60
.15 | 65
.20 | 70
.25 | 75
.30 | 80
.35 | 85
.40 | 90
.45 | 100

\[
\text{Infidelity: } t_{tx} \quad \Rightarrow \quad \bar{Y}_t
\]
\[
\text{Achieved Relative Strength } = .15
\]
\[
\text{"Infidelity": } t_{c} \quad \Rightarrow \quad \bar{Y}_c
\]
\[
d_{\text{with fidelity}} = \frac{\bar{Y}_t - \bar{Y}_c}{sd_{\text{pooled}}}
\]
\[
d = \frac{85 - 70}{30} = 0.50
\]
\[
d_{\text{with fidelity}} = \frac{90 - 65}{30} = 0.83
\]

**Expected Relative Strength = .25**

*Figure 1.* Representing fidelity and relative strength in experiments. Adapted from Cordray and Pion (2006, p. 116).
Ingredients

- Measure ingredients from treatment
- Measure ingredients from control
- Report both
- Take difference to correspond to effectiveness
Reading RCT

• Kindergarten program that integrates literacy and science
• Measuring ingredients from treatment and control
• Prominent resources: training, materials, database, coaching
• Less obvious: prep time, extra materials, parent involvement
Group Work
Groups

• Minimum of two people per group

• One person shares about a program being studied
  1. Paul Polanco
  2. Rachel Tripathy
  3. Michael Siller
  4. Donna Berthelsen
  5. Stephanie Hamilton

• One person takes down ingredients on laptop (excel or numbers)

• Report back

• Common themes or questions
Common Themes

• Whole-school reform
  • How much qualitative exploration do I need to collect ingredients

• Development Costs

• How far do we go?
  • You can make some assumptions

• Theory of change and choosing ingredients

• Quality of ingredients

• Personnel
  • Volunteers and their education

• Moderating variables, variation by site

• Life of materials
What if the outcome is not proximal?

What if mediators are related to the production of the outcome?
assessment/information/services ➔ change in track/service receipt ➔ outcome
assessment/information/services → change in track/service receipt → outcome
SERVICE

MEDIATION

INTERVENTIONS
Service Mediation
Interventions

• Intervention induces a change in service in other areas prior to the measurement of the outcome

• Direct costs of the intervention do not represent total cost to achieve outcome

• Many reforms in education fall into this category where a gap exists between the intervention and the measurement of the outcome
Comprehensive Student Support Services

• Students face many challenges prior to sitting in a classroom or that prevent them from participating fully in school

• Schools are partnering with community based organizations to provide services to students

• Fragmented, unsystematic, lacking integration with school
A BENEFIT-COST ANALYSIS OF CITY CONNECTS

July 2015
A. Brooks Bowden
Clive R. Belfield
Henry M. Levin
Robert Shand
Anyi Wang
Melisa Morales

CBCSE
Center for Benefit-Cost Studies in Education
Teachers College, Columbia University
www.cbcse.org
<table>
<thead>
<tr>
<th></th>
<th>Core + No Extra Service</th>
<th>Core + Full Services</th>
<th>Core + Estimated Service Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Connects program</td>
<td>$1,540</td>
<td>$1,540</td>
<td>$1,540</td>
</tr>
<tr>
<td>Mediated services</td>
<td></td>
<td>$7,530</td>
<td>$3,030</td>
</tr>
<tr>
<td>Full Cost (C)</td>
<td>$1,540</td>
<td>$9,070</td>
<td>$4,570</td>
</tr>
<tr>
<td>Effects (E)</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>C/E ratio</td>
<td>$3,950</td>
<td>$23,260</td>
<td>$11,720</td>
</tr>
</tbody>
</table>
How are the costs financed? Who pays?
Cost Distribution

• After listing all ingredients and estimating total cost, important to take next step to determine how costs are financed

• Portion of costs borne by the school?

• Volunteers?

• Others?
Leveraging Volunteers: An Experimental Evaluation of a Tutoring Program for Struggling Readers

Robin Jacob, Catherine Armstrong, A. Brooks Bowden & Yilin Pan
Example: Reading Partners

- For struggling students in K-5
- Supplemental pull-out reading program, Structured and individualized curriculum, Data-driven instruction
- One-on-one tutoring (2x45 minutes per week)
- Dedicated school space and materials
- Rigorous ongoing training with instructional supervision and support
- Run with volunteers supported by AmeriCorps Site Coordinators
- Site Coordinators supervised weekly by Program Managers
Evaluating RP

- Multi-site randomized design in 2012-1013
- 1,250 students randomly assigned at 19 school sites
- Grades 2-5, eligible for Reading Partners
- Baseline equivalence of treatment and control

Cost analysis was part of evaluation:

- What resources were needed to implement RP as per the evaluation?
- What proportion of RP costs were borne by the school?
- How did these resource requirements compare with the resources required to implement other supplemental reading services in these schools?
## Cost of Reading Partners per Program Group Student

<table>
<thead>
<tr>
<th>Cost</th>
<th>Cost per Student</th>
<th>Distribution of Cost per Student</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ingredients</strong></td>
<td></td>
<td>Cost to School</td>
</tr>
<tr>
<td>Reading Partners staff</td>
<td>690</td>
<td>690</td>
</tr>
<tr>
<td>AmeriCorps members</td>
<td>930</td>
<td>930</td>
</tr>
<tr>
<td>School staff</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Volunteer time and transportation</td>
<td>1,520</td>
<td>1,520</td>
</tr>
<tr>
<td>Facilities</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Materials and equipment</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total ingredients</strong></td>
<td><strong>3,610</strong></td>
<td><strong>390</strong></td>
</tr>
<tr>
<td>Fee for service ($)</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>AmeriCorps grant ($)</td>
<td></td>
<td>-320</td>
</tr>
<tr>
<td><strong>Net cost per student (Total ingredients + fee for service + AmeriCorps grant) ($)</strong></td>
<td><strong>710</strong></td>
<td></td>
</tr>
<tr>
<td>Portion of net cost per student (%)</td>
<td>20</td>
<td>42</td>
</tr>
</tbody>
</table>
CA: Takeaway Notes

• Gives better understanding of the program

• Programs typically cost more than guesstimated or proposed or in budget documents

• Substantial variation in costs for a given program

• Most programs are not high cost given what is expected to happen
Resources
Lessons learned

• Importance of understanding implementation context (Jacob, Armstrong, Bowden, & Pan, forthcoming)

• Identifying valid comparisons with regard to populations and outcome measures (Hollands, Kieffer, Shand, Pan, Cheng, & Levin, 2015; Hollands, Bowden, Levin, Belfield, Cheng, Shand, Pan, & Hanisch-Cerda, 2014)

• Challenges obtaining implementation and cost data retrospectively (Bowden & Belfield, 2015; Hollands, Bowden, Levin, Belfield, Cheng, Shand, Pan, & Hanisch-Cerda, 2014)

• Difficulty generalizing from study to wider population given high levels of site-heterogeneity (Bowden & Belfield, 2015)
Two CEA Examples

- High School Completion in EEPA

Cost-Effectiveness Analysis in Practice: Interventions to Improve High School Completion

- Early Literacy in JREE

Cost-Effectiveness Analysis of Early Reading Programs: A Demonstration with Recommendations for Future Research
Textbooks

• 1983—First edition of Cost-Effectiveness, setting out comprehensive methodology.

• 2001—Second edition incorporating advances and more on experimental and quasi-experimental effects.

• 2017—Third edition incorporating new knowledge; expected release summer 2017.
Computer-Assisted Instruction

Peer tutoring, class size, length school day

Dropout prevention

Early childhood literacy

Socio emotional learning

Lecture vs. small group instruction

Educational technology

Vouchers

Adolescent literacy

National service

Opportunity Youth (not working, studying or training)

Comprehensive school services

Nutrition
Apply for the training program!

• Held 4 training sessions, trained nearly 90 researchers in education

• Week long session with virtual follow-up and technical support

• cbcse.org

• Sign up for our listserv

• Next open session will be held in May in NY