Guide: Understand Types of Evidence

When making decisions about which technologies to use, you need evidence about which programs and policies are effective to make the best possible use of your technology budget. The quality of this evidence can vary widely, from marketing material to peer reviewed studies published in prestigious journals. This brief guide describes four key types of evidence you are likely to encounter among these sources and explains how to tell whether an evidence type can provide strong support for claims about effectiveness. The description of each type of evidence is accompanied by examples of information sources containing that type of evidence.

Anecdotal: Impressions from User Experience

Anecdotal evidence may include claims about a technology's effectiveness or other features, such as user experience, that are not necessarily related to the product's effectiveness. It usually is provided by a single user or a small group of users of a technology. This type of evidence cannot provide strong support for claims of effectiveness, because it is based on subjective impressions that may not be accurate. However, anecdotal evidence may provide an indication about the context in which a technology might be expected to be effective, or aspects of the user's experience that may enhance or reduce the technology's effectiveness. In general, anecdotal evidence can help identify products that are promising enough to warrant more rigorous research.

Common Source of this Evidence Type (follow link for example): marketing testimonials

Descriptive: Measuring Outcomes over Time

Descriptive evidence (for example, from a news article or marketing piece) describes characteristics of the target population and program participants. It examines outcomes for a given population over a period of time. This type of evidence is commonly found in marketing materials and informal or "anecdotal" sources. Since a descriptive evidence does not include a comparison group, it is impossible to know what would have happened without the program over this time period. Therefore, descriptive evidence alone cannot provide strong support for a program's (or app's) effectiveness on the outcome of interest.

For example, an infographic may claim that an educational technology "gets results" because student achievement is higher after using the technology than before. But several other factors, such as new leadership or other new programs, might be driving changes in achievement. This descriptive evidence does not provide evidence about the technology's true effectiveness since we don't know what would have happened in these schools without the technology.

Common Sources of this Evidence Type: marketing materials, news articles

Correlational: Comparing Users with Non-Users

Correlational evidence identifies patterns linking outcomes with educational conditions or initiatives, such as making an educational technology available. This type of evidence can be useful as a starting point when learning about a technology, but cannot conclusively demonstrate that that a technology gets results. This is because it cannot rule out other possible explanations for changes or differences in outcomes. Correlational evidence is often misinterpreted and used to demonstrate success.

For example, a correlational analysis might compare three groups of students: a small group that used a technology versus students in Title I schools in the same district, and students in the school district as a whole. Even if more students improved their performance among those who used the technology than in the other groups, there may be other important differences between technology users and the rest of the district that explain differences in improvement. Often, schools or students chosen to use a technology in a pilot are a special group; for example, they may be high-achieving students or they may be low-achieving students who have been selected to receive a number of other supports in addition to the technology.

Common Sources of this Evidence Type: blog posts or news articles
Less Common Source: grey literature

Causal: How to Measure What Works

Causal analysis is the only way to determine effectiveness with confidence. This type of analysis compares "apples to apples," the only difference being the program received by one group ("intervention") and not the other ("comparison"). The comparison group tells us what would have happened without the program; we can then say that differences in outcomes between the groups were caused by the program. There are several ways to create the comparison group needed to generate causal evidence, but a strong causal analysis must show that the intervention and comparison groups are equivalent in characteristics such as previous outcome measures and demographic characteristics. This equivalence is what convinces the reader that we are comparing apples to apples.

For example, any strong causal analysis of student achievement outcomes will measure and present differences in baseline characteristics and test scores of students in the intervention versus comparison group. This way, the reader can see whether the two groups are equivalent before the intervention group begins using the technology. If so, differences in outcome scores between treatment and control students can be interpreted as the effect of the technology. While a randomized controlled trial is often considered the "gold standard" in causal analysis, other methods can be used to identify or create a comparison group.

Common Sources of this Evidence Type: independent evaluations
Less Common Source: news articles

Example of Anecdotal Evidence: Marketing Testimonials

These testimonials make different types of claims about DreamBox Learning® products based on anecdotal evidence.

"I was a huge supporter of bringing DreamBox to Stubbs Elementary after seeing a huge success with it while I was assistant principal at Oberle last year. We saw more than a 15% increase in our math scores in one year and the only thing we did differently was use DreamBox. Based on Stubbs' State assessment data, closing the achievement gap in math is a priority. I am excited to see the impact it will have on our students here."

-- *Elementary School Assistant Principal*

This testimonial indicates that the program raised test scores. A rigorous evaluation would be needed to make a strong conclusion about this; changes in student body, teacher experience, or increasing familiarity with other recent reforms all might affect student achievement, without coming to mind as major changes from one year to another.

"My students love using Dreambox. They use it about 20 minutes a day. On average, my first grade class is working at a middle of second grade level."

-- *First grade teacher*

This statement indicates that the program is popular with students in this teacher's class. This anecdote might stimulate the reader's curiosity about the ideal amount of use per day, which could be assessed rigorously in a pilot. It is not clear how students' grade level of work is measured (for example, by the teacher's content standards versus those of the program).

"The Common Core Report is my favorite. It helps me to see exactly what areas the students are working on and passing. I can also see where they are having difficulty and spending more time. I use this data for small group time where I can focus on the specific areas that each student needs help."

-- *Second grade teacher*

This observation highlights one possible way the program could be used – to diagnose areas of difficulty in order to plan individualized instruction.

A rigorous rapid-cycle evaluation could evaluate whether students of teachers who pair program use with daily small-group instruction outperform students of teachers who also use daily small-group instruction but without tools developed by DreamBox Learning®.

Testimonials drawn from the DreamBox Learning® website.

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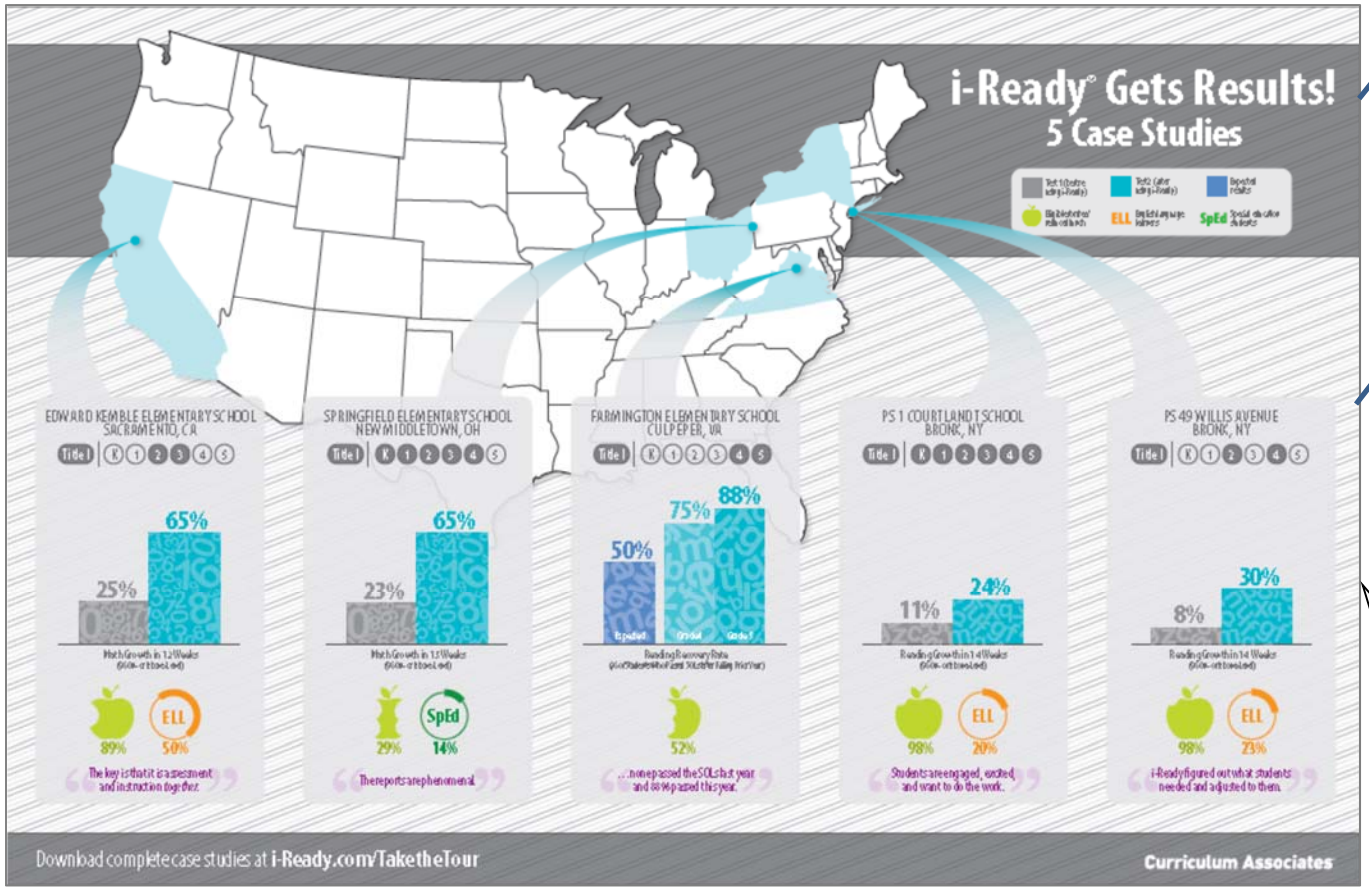
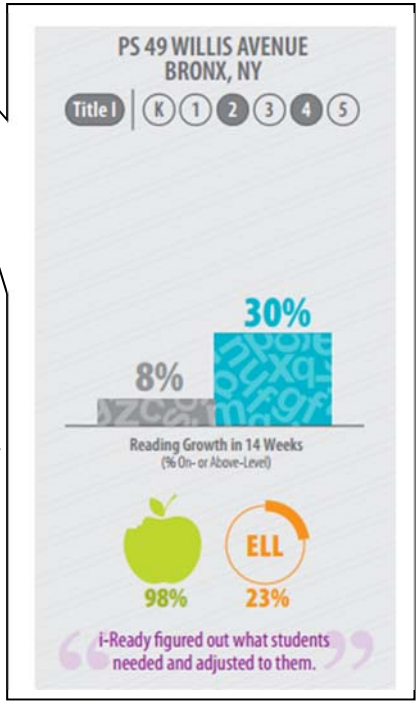
Example of Descriptive Evidence: Marketing Infographic



This infographic makes a claim about i-Ready's effectiveness. What type of evidence is presented?

As in the example below, each case study compares student achievement before and after using i-Ready.



Because the case studies do not include a similar comparison group, they are not able to provide information on what would have happened to student achievement without i-Ready.

Factors other than the use of i-Ready may have caused the changes in student achievement presented in these case studies. Therefore, the case studies do not provide strong evidence of i-Ready's effectiveness.

Because they do not include a comparison group, these are descriptive analyses rather than correlational or causal analyses.

Infographic drawn from the i-Ready website.

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Example of Descriptive Evidence: News Article

EDUCATION WEEK

Published Online: July 25, 2007
Published in Print: July 17, 2007, as **Software Improves Reading**

Software Improves Reading

By Kathleen Kennedy Manzo

This article includes some evidence on the effectiveness of a literacy software program– but what type of evidence?

Like Ms. Lebron, school leaders in the 55,000-student Paterson district, and their counterparts across the nation, are learning the benefits of incorporating computer-based features into the reading curriculum to help teachers address their students' varying skills and experience.

Teachers describe the perceived learning benefits of software such as the component included in the READ 180 program and the struggle to identify the "right" program.

During the 90-minute English/ language arts block at Eastside High, for instance, each of the 15 students in the remedial class gets a chance at using a computer to strengthen basic skills, including decoding, reading fluency, vocabulary, and comprehension. An audio feature allows students to record themselves reading or listen to a taped version of the text. The activities bolster group lessons on grammar, writing conventions, and literature, and equip students for tackling grade-level reading assignments independently, educators here say.

In the course of the school year, Ms. Valenz said, nearly all the students advanced two grade levels or more in reading, and most had mastered 9th grade work, skills that have carried over to their other schoolwork.

One teacher describes large learning gains among students who used the program, with nearly all students advancing two or more grade levels in reading.

Is this description strong evidence of the software's effectiveness?

No, because other factors may have caused the gains. The article cites changes in reading level over time but the changes could be due to many factors besides the program. The lack of a comparison group that did not receive the software program prevents us from knowing what would have happened without it.

This article presents descriptive, rather than correlational or causal, evidence.

Excerpted from a news article on the Education Week website.

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Example of Correlational Evidence: Blog Post

EDUCATION WEEK

Study: Struggling Math Students Gain Using Personalized, Blended Program

By Michelle Davis on December 4, 2014 10:29 PM

This blog post includes some evidence on the effectiveness of "School of One" – but what type of evidence?

Middle school students participating in a personalized, blended-learning math program showed increased gains in math skills—up to nearly 50 percent higher in some cases—over the national average, according to a new study from Teachers College, Columbia University.

The post cites a study that compares students who use School of One to national average test scores on the Measures of Academic Progress (MAP) test.

During the 2012-13 school year, students using Teach to One: Math gained math skills at a rate about 15 percent higher than the national average. In the second year of the program's implementation students made gains of about 47 percent above national norms, even though some of those students were still in their first year of using Teach to One: Math.

Students using the program showed substantially higher gains than the average student nationally.

Is this conclusive evidence of the technology's effectiveness? No, because other factors may have caused some of the gains. Since the comparison is <u>not</u> between groups constructed to be very similar, this is a <u>correlational</u>, rather than <u>causal</u>, analysis.

The follow-up study mentioned below is a more rigorous quasi-experimental study designed to provide a stronger answer about the program's effect on learning.

Ready cautioned that the data in the study did not allow him to conclude definitively that Teach to One: Math caused the skills improvements. However, New Classrooms Innovation Partners plans a more definitive trial over the coming two years in the Elizabeth, N.J. public schools, Rush said. New Classrooms, in partnership with the Elizabeth district, received a $3 million federal Investing in Innovation Fund grant to do that work.

Excerpted from a blog post on the Education Week website.

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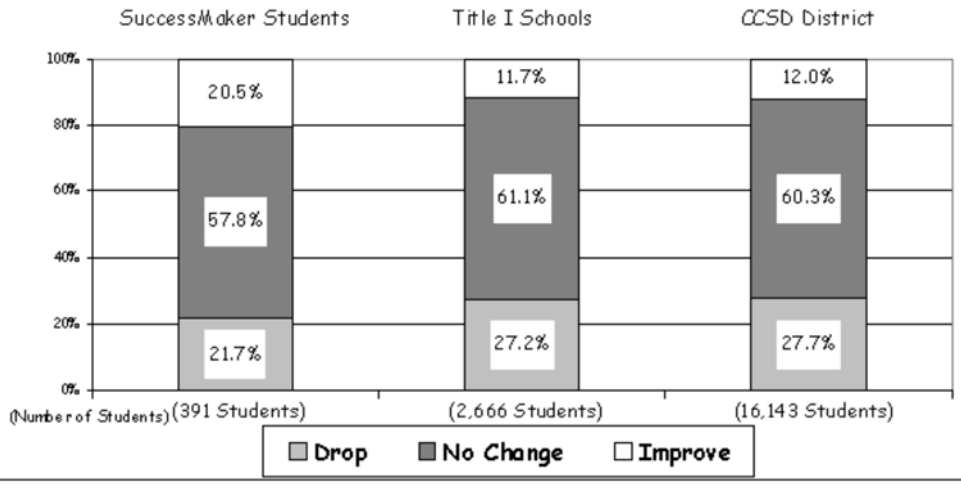
Example of Correlational Evidence: Grey Literature

Year Two Results: Evaluation of the Implementation and Effectiveness of SuccessMaker During 2002-2003

Charleston County School District

performance category. For both ELA and Math, Below Basic students who worked on SuccessMaker were more likely than Below Basic students in the comparison groups to improve their PACT performance category (in ELA, 36% of the Below Basic SuccessMaker

Figure 4: Changes from 2002 to 2003 in PACT English/Language Arts Performance Categories for SuccessMaker, Other Title I Schools, and CCSD Students in Grades 3-8



Excerpted from a report on the Charleston County School District's website.

This correlational study, conducted by a school district, presents information on the computer-based instructional program "SuccessMaker." Is this information strong evidence of effectiveness?

The study reports that students who used the program were more likely to improve on the state test (the PACT).

The study compares SuccessMaker users to students at other Title I schools and to the district as a whole.

However, the study does not include enough information on whether program users and their schools were similar to non-users in the comparison groups.

Some background information is provided, but it is not clear whether this information applies to the sample in Figure 4.

Differences in improvement may be due to SuccessMaker or other factors. This study does not provide strong evidence of effectiveness.

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SRI International

This report provides experimental evidence on the impact of the DreamBox Learning® Math program on kindergarteners' and first-graders' math achievement.

Evaluation of Rocketship Education's Use of DreamBox Learning's Online Mathematics Program

Haiwen Wang
Katrina Woodworth

This was an independent evaluation using a Randomized Controlled Trial (RCT) design. RCTs are the gold-standard for establishing causal effects. This means they can provide strong evidence on a program's effectiveness.

Exhibit 4 presents the means and standard deviations of the pre- and posttest scores (NWEA mathematics test scores in September 2010 and in January/February 2011) for the treatment and control students. The differences in pretest scores were in general less than 3 points, all within .2 standard deviations of the scores for the entire sample, and none of the differences were statistically significant at a .05 significance level, meeting the What Works Clearinghouse (WWC) standards for a balanced sample.

The strength of the evidence on DreamBox's impact relies on the fact that among students in the study, those who used the program were very similar to those who did not – in other words, the sample was "balanced". The paragraph and table to the left show that widely accepted standards for balance were met in this study. In particular, they found that students had similar scores on a baseline version of the test they used to measure outcomes – this is generally considered the most important aspect of balance.

Exhibit 4
Pre and Post NWEA Math Test Scores by Treatment and Control Condition

	Treatment					Control				
	Pretest			Posttest		Pretest			Posttest	
	N	Mean	*SD*	Mean	*SD*	*N*	Mean	*SD*	Mean	*SD*
Math overall	446	146.0	18.0	159.0	16.6	111	144.7	15.0	156.2	15.1
Problem solving	444	147.0	19.3	161.4	16.3	109	144.7	17.1	159.8	15.2
Number sense	444	146.9	20.0	159.6	18.9	109	143.4	16.6	157.0	17.2
Computation	438	147.5	22.4	163.0	20.7	108	147.0	19.8	158.8	19.5
Measurement and geometry	441	144.5	18.9	155.5	18.3	109	144.8	18.4	151.8	18.1
Statistics and probability	443	145.5	19.3	156.3	18.9	109	145.1	15.6	154.1	17.6

Exhibit 7
Summary of Regression Results for the ITT Effects on NWEA Mathematics Scores

	Math Overall	Problem Solving	Number Sense	Computation	Measurement and Geometry	Statistics and Probability
Effect on RIT scale score	2.30**	1.02	1.53	2.68	2.91*	2.20
S.E.	(0.83)	(1.11)	(1.23)	(1.41)	(1.23)	(1.36)
Effect size	0.14	0.06	0.08	0.13	0.16	0.12

*$p < .05$

As shown in the first row of Exhibit 7, DreamBox Learning® Math had a positive, and statistically significant, impact on tests of overall math skills and of measurement and geometry. The statistically significant impacts, marked with an asterisk, indicate that it is very unlikely that those differences in outcomes are due to chance.

Excerpted from a report available on the DreamBox Learning® website.

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Example of Causal Evidence: Blog Post

EDUCATION WEEK

Math App May Lend a Hand to Parents Nervous About Numbers

By Sarah D. Sparks on October 8, 2015 2:43 PM

In the latest in a series of studies on how adult anxieties and stereotypes affect students' math performance, University of Chicago researchers found that students whose families used a free tablet app to work through math-related puzzles and stories each week had significantly more growth in math learning by the end of the year, particularly if their families were uncomfortable with the subject.

In the randomized controlled trial, University of Chicago psychologists Talia Berkowitz, Sian Beilock, Susan Levine and others followed 587 1st graders and their families at 22 Chicago-area schools. The families were randomly assigned to use an iPad with either a reading-related app or a version of **Bedtime Math, a free app which provides story-like math word problems** for parents to read with their children. The children were tested in math at the beginning and end of the school year.

Notably, the students of parents who admitted dreading math at the beginning of the year showed the strongest growth from using the app at least once a week. That's important, since this study and prior research has shown **parents who are highly anxious about math have children who show less growth in the subject** and who are more likely to become fearful of the subject themselves.

This blog post presents information on the effectiveness of a technology called "Bedtime Math" – what type of evidence is presented?

"Students whose families used a free tablet technology to work through math-related puzzles and stories each week had significantly more growth in math learning by the end of the year."

The article reports results from a randomized controlled trial – the gold standard in causal analysis. Students who used the technology were randomly selected, so students who were not selected should be very similar to those who were. Because we would expect these groups to be equivalent prior to the trial, any difference in outcomes can be considered the effect of the technology.

Therefore, this article – and the study it reports on – present strong evidence on the effectiveness of this technology among this group of students.

Excerpted from an article on the EdWeek website.

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