Abstract

In the past two years alone, at least six systematic reviews or meta-analyses have examined the interventions that improve learning outcomes in low- and middle-income countries. However, these reviews have sometimes reached starkly different conclusions: reviews, in turn, recommend information technology, interventions that provide information about school quality, or even basic infrastructure (such as desks) to achieve the greatest improvements in student learning. This paper demonstrates that these divergent conclusions are largely driven by differences in the samples of research incorporated by each review. The top recommendations in a given review are often driven by the results of evaluations not included in other reviews. Of 227 studies with student learning results, the most inclusive review incorporates less than half of the total studies. Variance in classification also plays a role. Across the reviews, the three classes of programs that are recommended with some consistency (albeit under different names) are pedagogical interventions (including computer-assisted learning) that tailor teaching to student skills; repeated teacher training interventions, often linked to another pedagogical intervention; and improving accountability through contracts or performance incentives, at least in certain contexts. Future reviews will be most useful if they combine narrative review with meta-analysis, conduct more exhaustive searches, and maintain low aggregation of intervention categories.

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What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews

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1. Introduction

Education quality remains an elusive goal in many developing countries. While countries around the world have made great strides in increasing access to education, much of this education is still of low quality, with low learning outcomes reported in Africa, Latin America, and elsewhere (Bruns & Luque 2014; Filmer & Fox 2014; UNESCO 2014). At the same time, evidence suggests – unsurprisingly – that additional years of schooling have little impact on economic growth in the absence of learning, which is a function of education quality (Hanushek & Woessman 2007). At the same time that governments seek to increase the quality of education, the use of experimental and quasi-experimental methods to measure the effectiveness of education interventions in developing countries has become increasingly common. This has resulted in hundreds of studies from around the world demonstrating the effectiveness (or ineffectiveness) of various interventions at improving student learning. These interventions range from providing information about the quality of schools to parents, to training teachers in scripted literacy instruction, to dropping laptops off for students.

To make sense of all this evidence, various researchers have undertaken systematic reviews of these impact evaluation studies. In 2013 and 2014 alone, at least six reviews of studies seeking to improve student learning in primary schools in developing countries were published in journals or released as working papers. These include Conn 2014, Glewwe et al. 2014, Kremer, Brannen, & Glennerster 2013, Krishnaratne, White, & Carpenter 2013, McEwan 2014, and Murnane & Ganimian 2014.[1] Between them, they review 301 studies from across the developing world: 227 of those studies report learning outcomes, and 152 report enrollment or attendance outcomes. There are differences in the scope of the reviews: Some focus only on primary education whereas others explore both primary and secondary, some only look at learning impacts while others also consider enrollment or attendance, one has a regional focus (Sub-Saharan Africa), two include only randomized controlled trials (RCTs), and three have a well-defined time frame. Yet, as the common denominator, all of these reviews include RCTs implemented in Sub-Saharan Africa with learning outcomes at the primary school level, published roughly between 1990 and 2010, so the expected overlap is substantial.

Despite that, the main results they highlight for improving learning appear inconsistent. For example, using a subset of the conclusions for each review, Conn (2014) highlights pedagogical interventions as most effective, while McEwan (2014) finds the largest effects for interventions involving computers and technology. Kremer, Brannen, & Glennerster (2013) highlight pedagogical reforms that match teaching to student learning levels as well as the incentives associated with hiring teachers on short-term contracts. Glewwe et al. (2014) emphasize the impact of teacher knowledge, teacher absenteeism and the availability of student desks on student learning. Krishnaratne, White, & Carpenter (2013) underline the importance of learning materials. And Murnane and Ganimian (2014) emphasize providing information about school quality and returns to schooling, among other findings.

[1] Murnane & Ganimian was published in July 2014 as a National Bureau of Economic Research working paper (Murnane & Ganimian 2014a). For this study, we draw on an updated, unpublished version provided by the authors dated November 18, 2014. Although the sample of studies varies across the two versions, the conclusions are exactly the same.

Given the massive array of evidence, and the apparent divergence in conclusions from the reviews of the evidence, how is one to understand what actually works best to improve learning in developing countries? In this paper, we critically examine these recent reviews to understand the underlying reasons for the observed divergence in conclusions. We also characterize the heterogeneity of effectiveness within categories of interventions. Finally, we highlight the common themes across the reviews – sometimes obscured by differences in categorization – in terms of what kinds of interventions are more and less effective.

We find that much of the divergence in conclusions is driven by strikingly different compositions of studies across the reviews: Of the 227 studies that look at learning outcomes, only three are included in all six systematic reviews, whereas almost three-quarters (159) are included in only one of the reviews. While some of these compositional differences are driven by explicit exclusion rules (e.g., some reviews include only randomized trials and one focuses only on evidence from Sub-Saharan Africa), many are not. This divergence does not mean that reviews are incorrect in characterizing what works well: The main conclusions of each review are supported by evidence from papers that attempt to explicitly establish a counterfactual. Indeed, the strongest positive results in each review are driven by randomized controlled trials. However, each review incorporates different evidence, leading to different ultimate conclusions.

We also observe that much of the variation in outcomes across educational interventions is captured within categories of interventions rather than across them. Highlighting the average effectiveness of a given category of intervention may be less useful than characterizing the narrower types of interventions within that category that drive high returns: For example, saying that computer interventions are most effective may be less useful and less accurate than saying that computer-assisted learning programs which are tailored to each student's level of knowledge, tied to the curriculum, and that provide teachers with training on how to integrate the technology into their instruction are most effective.

Finally, we find that there is indeed some intersection in recommendations across the reviews, although that intersection is masked with different labels. Even given the small degree of overlap in the composition of review samples, we find broad support across the reviews for (i) pedagogical interventions that match teaching to students' learning, including through the use of computers or technology; (ii) individualized, long-term teacher training; and (iii) accountability-boosting interventions, such as teacher performance incentives and contract teachers.

2. Methods

This paper takes as its population the set of reviews of impact evaluation evidence on improving student learning in developing countries identified in 2013 and 2014. We restrict this analysis to reviews of evidence on how to improve learning, as opposed to increasing access (although many of the reviews also include evidence on the latter).[2] Note the caution that test scores, even when converted into standard

[2] For the purposes of this paper, student learning is measured by test scores in math, language, science, or cognitive assessments, as determined by the inclusion criteria of the six systematic reviews. Specifically, the meta-analyses (three of the reviews) use standard deviations of test scores to measure learning impacts so as to allow comparison across different tests administered in different contexts.

deviations, are not necessarily comparable. For example, literacy tests focusing on different skills (e.g., narrower versus broader measures of literacy) may deliver different average effect sizes (Hollands et al. 2013). Likewise, an intervention may seem ineffective if it is evaluated using a very difficult test which virtually no students could pass even after the intervention (i.e., the floor effect).

We include systematic reviews that examine heterogeneous interventions with a common goal, improving student learning. An alternative approach, employed in other systematic reviews, is to select a single intervention or class of interventions and examine their effectiveness across one or more goals. For example, Bruns, Filmer, & Patrinos (2011) take the latter approach for accountability reforms in education; Baird et al. (2014) do the same for cash transfers. If the goal is to identify the best interventions to improve student learning, then the first approach makes the most sense. If the goal is to identify the best model within a class of interventions or whether a class of interventions is effective overall, then the second approach may be more appropriate.

We also include only reviews that examine the effectiveness of improving learning at the primary level, although they need not exclusively examine the primary level. Some reviews, such as Petrosino (2012), focus on enrollment rather than learning and so are not included; one review that is included, Krishnaratne (2013), employs the sample of studies developed in Petrosino (2012). Likewise, Banerjee et al. (2013) is excluded because it focuses exclusively on post-primary education; note, though, that Banerjee et al. (2013) uses the subset of studies from Glewwe et al. (2014) which report post-primary education outcomes as its universe, adding only a handful of additional studies exclusively focused on post-primary education.

In examining the eligible reviews, we examine (i) the main conclusions; (ii) the exclusion rules; (iii) the variation in the composition and categorization of included studies for at least one key conclusion area (e.g., pedagogical interventions, additional school resources) from each review;[3] and (iv) the heterogeneity across results within intervention category. We then use the studies at the intersection of conclusions across reviews to discuss the implications for education policy.

3. Results

3.1 The Reviews and the Studies beneath the Reviews

We discuss six reviews in this study: Conn (2014), Glewwe et al. (2014), Kremer, Brannen, & Glennerster (2013), Krishnaratne, White, & Carpenter (2013), McEwan (2014), and Murnane & Ganimian (2014). These include, fundamentally, three types of review: The first of these, meta-analysis, converts the results of all the included studies to standardized point estimates and then pools the estimates within a category of interventions (e.g., all the studies on providing school meals) to estimate the average effect of that category of intervention with greater statistical power.[4] Second, the narrative review examines the

[3] We examine the variation in the categorization of included studies for one key conclusion area for each review except Glewwe et al. (2014), which does not identify which of the studies it reviews fall into which category.

[4] Meta-analysis consists of a weighted average of regression results across individual studies and can be carried out with any number of studies. Meta-regression analysis is a subset of meta-analysis which incorporates these results

evidence qualitatively, usually discussing study by study, and then infers conclusions. Third, the vote counting review shows the pattern of significant and insignificant positive and negative impacts across studies and draws inferences from that. Across these types, reviews vary in how systematically they define the strategy used to identify the papers reviewed.[5]

Each method has its advantages and disadvantages (Koricheva & Gurevitch 2013), as summarized in Table 1. Narrative reviews are often written by recognized experts in the field, who may have broad familiarity with the topic. These reviews provide the ability to reflect on nuances across studies and their underlying interventions, and to draw conclusions from these. This is particularly valuable where there is variation in the effectiveness at improving student learning *within* a given intervention category, which there often is. In other words, when not all technology-based interventions are equally good at improving learning, for example, narrative reviews are well suited to discussing which elements of such interventions are more or less effective. Narrative reviews may also be more effective than other reviews at exploring the mechanisms behind the effectiveness of interventions using economic theory and intuition. However, these reviews rely on a subjective weighting of the evidence by the reviewer, which may become less reliable as the number of studies reviewed increases. Also, because the weighting is qualitative, it may not be completely transparent to the reader, especially if not all reviewed studies are reported.

Vote counting has the appeal of simplicity, but it ignores sample size, statistical precision (except for significance cut-offs), and effect size, and so may overemphasize small significant effects at the expense of large effects that narrowly miss a significance cut-off.[6] Meta-analysis is more labor-intensive to implement, but since it aggregates results across studies into a single meta-result, it incorporates the data that vote counting excludes (e.g., effect size) while potentially increasing statistical power by pooling across smaller studies. Meta-analysis also permits controlling for the quality of studies or other moderating factors, as Conn (2014) and McEwan (2014) do in their meta-analyses. However, because meta-analysis requires pooling estimates across studies, studies that fail to report certain elements of the underlying data may be excluded, despite the studies being of high quality in other respects (e.g., internal validity). Meta-analyses also tend to use higher levels of aggregation (e.g., "pedagogical interventions") than narrative reviews, which can be less helpful if there is a great deal of variation within the broad class of intervention.

Of the six reviews considered here, three are meta-analyses – Conn (2014), McEwan (2014), and Krishnaratne, White, & Carpenter (2013); two are narrative reviews – Kremer, Brannen, & Glennerster (2013) and Murnane and Ganimian (2014); and one is a vote count – Glewwe et al. (2014), as shown in Table 2. However, several of the reviews have elements that cross categories. Kremer, Brannen, & Glennerster (2013), while a narrative review, does present standardized coefficients across many of the

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in a regression, permits controlling for moderating factors (such as study quality or implementing agency), and requires a minimal sample size. Conn (2014) and McEwan (2014) both include meta-regression. Krishnaratne et al. (2013) is a meta-analysis but does not report meta-regression results.

[5] All reviews except Kremer, Brannen, & Glennerster (2013) document an explicit search strategy, including the keywords used and literature databases searched.

[6] Ziliak & McCloskey (2014) discuss the policy cost of focusing on narrowly defined statistical significance at the expense of effect size.

studies considered. Krishnaratne, White, & Carpenter (2013) reports meta-analysis results in the appendix but is written in the format of a narrative review. Conn (2014) presents detailed meta-analysis but also a detailed narrative discussion of individual studies.

The reviews vary extensively in the number of studies incorporated and the official inclusion criteria (Table 3). The median number of learning studies reviewed is 61, with a minimum of 30 (Kremer, Brannen, & Glennerster 2013)[7] and a maximum of 92 (Murnane & Ganimian 2014). The total number of learning studies, across the six reviews, is 227. These are drawn from across the world, with more than 20 studies in each of China, India, and Kenya (Table 4 and Figure 1). The total number of learning studies available has grown significantly over time (Figure 2), from 30 cumulative studies in 2000 to 32 studies coming out in 2013 alone.[8] Taken together, this collection of studies likely reflects a close approximation of the total impact evaluation evidence on learning in developing countries over the last 25 years.

The reviews differ somewhat in geographical focus (Table 5). On average across the reviews, 34 percent of studies assess the effectiveness of learning interventions in Sub-Saharan Africa, 25 percent in Latin America and the Caribbean, 19 percent in East Asia and the Pacific, 16 percent in South Asia, and almost no studies in the Middle East and North Africa or Europe and Central Asia. While most reviews reflect this pattern, there is some divergence from the mean, most notably in Conn (2014) and Kremer, Brannen, & Glennerster (2013). By design, all of the studies included in Conn (2014) evaluate learning interventions in Sub-Saharan Africa, although 4 percent of these also provide results for countries in South Asia. Kremer, Brannen, & Glennerster (2013) include a high proportion of studies from Sub-Saharan Africa (40 percent) and South Asia (33 percent), with other regions under-represented relative to the average.

Two reviews include only randomized controlled trials, Kremer, Brannen, & Glennerster (2013) and McEwan (2014). The others include RCTs as well as quasi-experimental methods, with slightly differing criteria for which methods qualify. One review has a geographic focus: Conn (2014) reviews only studies from Sub-Saharan Africa. Two examine primary school only (Kremer, Brannen, & Glennerster 2013 and McEwan 2014), while the others include secondary school or other levels in addition to primary school. Only three impose an explicit criterion for study publication date, Glewwe et al. (2014) and Krishnaratne, White, & Carpenter (2013), both roughly 1990-2010, and Conn (2014), 1980-2013. All the reviews include RCTs, primary school outcomes, studies in Sub-Saharan Africa, and studies released between 1990 and 2010.

The learning studies included in the reviews fall broadly into three publication categories: published journal articles, unpublished working papers, and reports. Table 6 presents the distribution of learning studies across these categories for each review. Across the reviews, a slight majority of the learning studies included are journal articles (63 percent). This suggests there may be some degree of publication bias driving the studies included, but the proportion of published articles is not overwhelming and could

[7] We arrive at Kremer, Brannen, & Glennerster (2013)'s sample of 30 studies by including all those studies for which they provide a point estimate of the evaluated program's impact on test scores (18 studies), as well as those whose impacts (positive or negative) are explicitly discussed in the text.

[8] Similarly, the total number of studies evaluating either learning or access outcomes (or both) has grown significantly from 35 cumulative studies in 2000 to 301 studies by 2014, with more than 40 studies in 2013 alone.

merely reflect reviewers' preferences for the inclusion of high quality studies. The second most prominent category of studies is working papers, which accounts for 32 percent of learning studies on average. This proportion ranges from 7 percent of learning studies for Glewwe et al. (2014) to 50 percent for McEwan (2014), suggesting substantial variation in reviewers' inclusion of unpublished work. Lastly, only 5 percent of all learning studies reviewed are reports, with less variation across reviews.

As they are reported in the reviews, the main conclusions recommend somewhat different categories of interventions (Table 7). Conn (2014) finds the best results for pedagogical interventions as well as for student incentives.[9] She also finds positive results for extending the length of the school day, but only based on one study. Glewwe et al. (2014) find evidence that desks, chairs, and tables improve student learning, as well as teacher subject knowledge and teacher presence. Kremer, Brannen, & Glennerster (2013) identify pedagogical interventions to match teaching to students' learning, school accountability, and incentives as being highly effective. Krishnaratne, White, & Carpenter (2013) identify the provision of school materials as effective. McEwan (2014) identifies several effective classes of interventions, including – in descending order of mean effect size – computers or instructional technology, teacher training, smaller classes, smaller learning groups within classes, or ability grouping, contract or volunteer teachers, student and teacher performance incentives, and instructional materials. Finally, Murnane and Ganimian (2014) recommend providing information about school quality and returns to schooling, teacher incentives (in very low performance settings), and providing specific guidance for low-skilled teachers to help them reach minimally acceptable levels of instruction.

There seems to be more agreement on what is not effective in increasing student learning: three reviews demonstrate that school health interventions, including deworming, do not improve test scores, although one of those reviews – Conn (2014) – at the same time shows that health interventions do improve direct cognitive tests (of attention and memory) but not school language and math tests. Three reviews also argue that reductions in school fees do not improve student learning, although these clearly may improve student access to school.

3.2 Variation in Composition and Categorization

How much of this variation in conclusions is driven by the composition of the studies included, and how much is driven by differing categorization of similar studies? In terms of composition, the reviews include 227 learning studies between them, and the most inclusive single review (Murnane & Ganimian 2014) includes just over 40 percent of the total sample of papers. The least inclusive review (Kremer, Brannen, & Glennerster 2013) includes 13 percent of the total sample (Table 8).

The overlap across these reviews is surprisingly limited. Almost three-quarters of all the learning studies across the six reviews (159 studies) are included in only one of the six reviews. Only 3 studies (1 percent of the total) are included in all of the reviews (Figure 3): A study of textbook provision (Glewwe et al.

[9] Conn's (2014) estimate for student incentives is based on only two studies, however, containing four treatment arms in total.

2009), a study of flipchart provision (Glewwe et al. 2004), and a study of student incentives (Kremer, Miguel, & Thornton 2009), all in Kenya.

One natural explanation for the difference in composition is the inclusion rules of the reviews. Conn (2014) only includes studies in Sub-Saharan Africa, for example. However, if one looks at the studies that are included in all but one of the reviews, allowing for the possibility that many studies may be included in all reviews except Conn (2014), one finds only 4 studies (again, out of a total of 227). If one expands the field to studies included in most reviews (4, 5, or all 6), a total of only 13 studies achieve this (6 percent of the sample). Some of this exclusion may also be based on measures of quality, whether subjective or based on explicit criteria – e.g., Murnane and Ganimian (2014) exclude studies that rely exclusively on fixed effects or matching methods. While some exclusions are justified by explicit search restrictions, many are not. To illustrate this point we contrast two studies. The first, Angrist & Lavy (2001), is an evaluation of a teacher training intervention in Israel, evaluated using a matching strategy. The second, Gee (2010) is an RCT of an anti-malarial program with learning outcomes in Kenya. We can easily see why Angrist & Lavy (2001) would be excluded from Conn (2014) and Murnane and Ganimian (2014); the former focuses on Sub-Saharan Africa and the latter explicitly excludes matching studies. Gee (2010), however, falls into the common denominator of inclusion criteria across almost all reviews: it is an RCT with learning outcomes at the primary school level, in Sub-Saharan Africa, published between 1990 and 2010. According to the stated search strategies of the reviews therefore, there is no reason why it should be excluded from any review except Krishnarate, White, & Carpenter (2013), who cut off their search in 2009. In practice, however, it is only included in Conn (2010).

Other distinguishing inclusion criteria include that two reviews only include RCTs, whereas the other four include RCTs and studies using quasi-experimental methods. However, even with randomized trials the overlap in studies is limited (Table 8 and Figure 4). Of 134 learning RCTs, over half (74 studies) are included in only one review. As with the wider collection of learning studies, only 13 studies are included in most (4, 5, or 6) of the reviews. The largely non-overlapping collection of studies is apparently driven neither by geography nor by methodology.

While there are differences in the scope of each review, we consider each inclusion criterion common to all reviews, successively - learning outcomes, primary school, RCTs, the 1990-2010 time frame, and implementation in Sub-Saharan Africa – to examine how much of the variation in composition is driven by inclusion criteria (Table 8). Across the overall sample of 301 studies, 227 look at learning outcomes. Coverage of these learning studies in any single review is low, ranging from 30 studies (13 percent) in Kremer, Brannen, & Glennerster (2013) to 92 studies (41 percent) in Murnane & Ganimian (2014). To account for the fact that this might be driven by inclusion restrictions on methodology, we next consider the 134 RCTs with learning outcomes. Among these, coverage in any single review is even lower, ranging from 12 studies (9 percent) in Glewwe et al. (2014) to 68 studies (51 percent) in Murnane & Ganimian (2014). We next add restrictions for studies which include primary level outcomes and which were published between 1990 and 2010. Of the 107 studies fulfilling all of the above requirements, only between 11 percent and 60 percent of studies are included in any single review.

Finally, we consider the common denominator of inclusion criteria across all reviews: RCTs with learning outcomes at the primary school level, published between 1990 and 2010, in Sub-Saharan Africa. Of the 42 studies fulfilling all five of these requirements, still only between 10 percent and 79 percent of studies are included in any single review. This suggests that variation in composition is not remotely explained by the inclusion criteria of the reviews; if it were, we would expect the coverage of studies at the common denominator level to be much closer to 100 percent for each review. While there are differences across reviews in the proportion of studies that are published papers (i.e., a publication bias in inclusion), as shown in Table 6, there is no clear pattern between publication bias and coverage. This suggests that there is more behind variation in composition than systematic inclusion decisions.

At the same time, the reviews sometimes categorize studies in different ways. Many interventions fall into multiple categories, and studies tend not to provide sufficient information for reviewers to apply a systematic rule for allocating interventions to categories. Thus these discrepancies are not due to any error on the part of the reviewers; rather the allocation of interventions to categories is inherently subjective. Table 9 shows the 12 studies included in most or all of the reviews and how they are categorized in each review. Two of the three studies cited in all six reviews are variously characterized as "school supplies," "instructional materials," "materials," etc., all reasonably interpreted as similar categories. At the same time, the third study included in all six reviews (a study of merit-based scholarships for students) is categorized in four reviews as student incentives or merit scholarships, whereas two reviews categorize it as school fees or cash transfers. This is a fundamental difference in categorization: the former focuses on the incentive element of the intervention, whereas the latter focuses on the cost reduction element. In general, Krishnaratne, White, & Carpenter (2013) tends to categorize studies that most other reviews put into some sort of "computer" category simply as "materials", those that most others consider "teacher training" also as "materials", and studies that most reviews characterize as teacher incentives simply as "additional teaching resources".

Another notable difference in categorization is that of Conn's (2014) "Pedagogical interventions" and McEwan's (2014) "Computers or instructional technology", which are responsible for each review's strongest conclusion. While the labels of these two groups are quite different, the samples overlap greatly since a significant subset of Conn's pedagogical interventions are computer-assisted learning programs. This and the Krishnaratne, White, & Carpenter (2013) examples illustrate that much of the difference in categorization across the reviews is explained by the various reviews either (1) opting for different levels of disaggregation in their analyses (e.g., pedagogy versus computer-based pedagogy) or (2) focusing on a different element of the intervention.[10] Beyond these examples, however, many of the reviews have categories that are easily recognizable as synonymous or at least widely overlapping. Thus, categorization – especially for Krishnaratne, White, & Carpenter (2013) – can be an additional driver of at least apparently divergent conclusions.

What is the role of composition and categorization in driving the different conclusions? We selected a primary conclusion from each review and then analyzed which studies drive that conclusion and whether those studies are included in the other reviews. For the five reviews for which we conducted this analysis,

[10] McEwan is the only paper with explicitly overlapping categories.

we selected the primary conclusions of each review by choosing: (1) for the meta-analyses, the category with the largest significant pooled effect size or most prominent result as defined by the review (for Krishnaratne, White, & Carpenter (2013) this is the category with the biggest significant effect when 6 or more studies are pooled together); and (2) for the other reviews, the first positive conclusion mentioned. (This analysis was not possible for Glewwe et al. 2014 because it does not identify which studies fall into which category.) The results of this analysis are summarized in Table 10. Considering Conn's (2014) finding that pedagogical interventions are the most effective, a tiny fraction of all of Conn's pedagogical studies are incorporated in any other study (6 percent in three other reviews, none in Kremer, Brannen, & Glennerster 2013, and 18 percent in Murnane & Ganimian 2014). Likewise, for McEwan's "computers or instructional technology" category, fewer than half of his studies are included in any other review except Murnane & Ganimian (2014), which includes 70 percent of McEwan's studies. Table 11 repeats this analysis for RCTs only and demonstrates, again, large variation in composition. Notably, the composition analysis of the samples driving the main conclusions for RCTs only is almost identical to that which includes all studies, suggesting that the main conclusions of each review are driven by evidence from RCTs.

In Tables 11 through 15, we analyze the recommendations of each review in detail. For example, in Table 12, we see that although Conn has 17 studies in the "pedagogical interventions" category, few are included in other studies. The three studies with the largest effect sizes are not included in any other review. When considering Kremer, Brannen, & Glennerster's recommendation of pedagogical interventions that match teaching to students' learning (Table 13), there is more but still limited coverage: one of the two studies driving this conclusion is in four of the other five reviews, whereas the other study is in three of the other five. (As a result, this conclusion, in some form, makes it into multiple reviews, as discussed in the next section.)

For Krishnaratne, White, & Carpenter's finding supporting "materials provision" (Table 14), the three studies that seem to be driving this result are included in some other reviews (one of the studies is in four other reviews, whereas the other two are in just one or two). But most other reviews categorize those three studies as computer-assisted learning. In that case, categorization may be driving some of the result. With McEwan's (2014) finding of the effectiveness of computing interventions, many of the driving positive studies are excluded from other reviews (Table 15). Finally, in Murnane and Ganimian (Table 16), the finding on information provision is driven by studies that are often not included in other reviews but – when they are – they are categorized similarly.

Thus, differences in composition seem much more likely to drive variation in conclusions than differences in categorization, although categorization also plays a role. No review includes even half of the total sample of studies. As a result, it may be unwise to rely on a single review to derive a conclusion about the most effective interventions to improve student learning. But each review relies on clear empirical evidence to determine what works well in some settings. So these reviews may be more effective at providing ideas for what works well to improve learning rather than definitively characterizing what works best.

3.3 Variation within Intervention Categories

As some of the reviews highlight, much of the variation in learning results across studies is driven by variation *within* categories. Just because a given intervention falls into a category which is effective at improving student learning on average, this does not mean that it will perform per the mean of that category; it is the specific details of the intervention which determine its effectiveness. When Conn (2014) concludes that pedagogical interventions are most effective, or when McEwan (2014) concludes that computer interventions are most effective, this can mask the massive heterogeneity within the category. Both reviews discuss this. It is important to note that many pedagogical interventions have been ineffective, as have many computer interventions.

For example, while McEwan (2014) finds computer-based interventions to be by far the most effective category, the One Laptop Per Child (OLPC) program in Peru had little or even negative effects on student learning, apparently because it distributed computers without any additional training (Cristia et al. 2012). Even within the sub-category of OLPC programs there is great heterogeneity; a recent program which distributed laptops installed with remedial tutoring software to migrant children in Beijing and trained them in their use, produced large increases in standardized math scores (Mo et al. 2012). Similar heterogeneity also exists within low performing intervention categories. Conn (2014) finds interventions providing school supplies to have a low average effect (0.022 standard deviations), for example, yet unanticipated school grants for textbooks in Zambia (Das et al. 2013) are roughly five times more effective than the mean of this category.

Table 17 demonstrates this more systematically for the sample in McEwan (2014). For each of his intervention categories, we summarize the variation within category and in the total sample. In five out of eleven categories, the standard deviation of effects is larger within the category than for the overall sample of studies. And for five of the remaining six categories, the standard deviation of effects within the category is at least half that of the whole sample. In all cases, there is a great deal of heterogeneity within the category. As a result, it is crucial to examine not just which categories of interventions are most effective, but rather which specific interventions have been effective within that category, and the elements particular to those interventions.

4. What Works Well: Intersections across Reviews of Improving Learning

Despite differing conclusions from each review (Table 7), is there any intersection in what works? At first glance, there is no convenient overlap in the categories of interventions deemed most effective. But upon closer analysis, despite the differing samples and some degree of different characterization, there is some agreement. We examine the specific studies driving the conclusions of each paper and highlight the programs most often identified to be effective as well as those consistently found to be ineffective. In this discussion we group interventions using the lowest possible level of aggregation so as to highlight the specific elements driving the relative effectiveness or ineffectiveness of certain types of programs.

4.1 Pedagogical interventions that match teaching to students' learning

Across the six reviews, the intervention category which most commonly produces large improvements in student learning is pedagogical interventions that match teaching to students' learning, including through the use of computers or technology. This comes out particularly strongly in Conn (2014), Kremer, Brannen, & Glennerster (2013), and McEwan (2014), all of whom give this category a slightly different name ("Pedagogical interventions", "Pedagogical interventions to match teaching to students' learning", and "Computers or instructional technology", respectively) but are essentially referring to the same group of driving interventions.

Conn (2014) finds that, across her sample of African studies, pedagogical interventions (which she defines as those that change instructional techniques) are more effective at improving student learning than all other types of interventions combined. Within the category of pedagogical interventions, she finds that studies that employ adaptive instruction and teacher coaching techniques are particularly effective.[11] Among these interventions, the pooled effect size associated with adaptive instruction is 0.42 standard deviation, while that of programs with non-adaptive instruction is about one-quarter that, at only 0.12 standard deviation.[12] All three studies in Conn's sample which evaluate adaptive instruction interventions report positive, statistically significant effects on student literacy scores (Korsah et al. 2010; Piper and Korda 2011; Spratt et al. 2013).

Programs with adaptive instruction fall into two categories: (i) computer-assisted learning (CAL) programs which adapt to the student's learning level or (ii) teacher-led methods that emphasize formative assessment and individualized and targeted instruction. While Conn finds both computer-assisted and teacher-led methods to produce a significant improvement in student performance (at the 10 percent level), the effect of the former is twice as large as the latter. One example of teacher-led adaptive instruction is the Early Grade Reading Assessment program in Liberia evaluated by Piper and Korda (2011), in which students' reading levels were evaluated using a diagnostic exam, and teachers were then trained in how to continually assess student progress. Another example, categorized differently by Conn but argued to help teachers adapt instruction in Kremer, Brannen, & Glennerster (2013) and included in four of the six reviews, assigned students in Kenya to classes on the basis of initial preparedness so that teachers could focus instruction at the level of learning of the students (Kremer, Duflo, and Dupas 2011). This increased test scores at all levels of initial preparedness.

Along the same lines, McEwan (2014) finds computer-assisted learning programs to have a greater impact than other kinds of interventions, with a mean effect size of 0.15 (significant with 99 percent confidence), which he finds is not driven by overlapping treatments. A successful example included in McEwan (2014) but also highlighted by Kremer, Brannen, & Glennerster (2013) is a CAL program in India, which – using math software that allowed children to learn at their own pace – increased math scores by 0.48 standard deviation, significant with 99 percent confidence (Banerjee et al. 2007). Moreover, the latter program was

[11] For this sub-group analysis, Conn limits the sample to what she rates as high quality studies.
[12] The samples are small (3 studies in adaptive instruction and 5 studies in non-adaptive instruction), so Conn does not report p-values.

extremely cost-effective, producing an increase of 3.01 standard deviations in test scores per $100 spent (Kremer, Brannen, & Glennerster 2013).

However, as Murnane & Ganimian (2014) highlight, such programs do not improve student achievement unless they change children's daily experiences at school. Computer-assisted learning programs are ineffective when instruction is not tailored to each student's level of knowledge, when technology distribution is unaccompanied by parent or student training as was the case in Peru's One Laptop Per Child program (Cristia et al., 2012), when computers substitute away from useful instructional time during school hours (He, Linden, & MacLeod 2008) or home study (Malamud & Pop-Eleches 2011), or when the treatment is not tied to the curriculum or integrated by teachers into their classroom instruction (Barrera-Osorio & Linden, 2009).[13]

Taken together, there is significant overlap in these recommendations: Computer-assisted learning or teacher-led interventions that individualize instruction can be highly effective. But pedagogical interventions or computing interventions generally are not inherently more effective than others; they have to be well implemented and affect students' learning experience.

4.2 Individualized, repeated teacher training, associated with a specific method or task

The category of interventions found to produce the second largest effects in two of the meta-analyses and that is also highlighted in one of the narrative reviews is teacher training. McEwan (2014) finds teacher training to produce a 0.12 standard deviation improvement in learning (significant with 99 percent confidence), for example.[14] Again, examining the specific programs is crucial: Providing teachers with general guidance tends not to improve student learning, but Murnane & Ganimian (2014) find that detailed support tailored to the skill levels of teachers can be effective. For example, an Indian program giving teachers diagnostic information about student performance with general tips on how to help them improve had little impact on student learning (Muralidharan & Sundararaman 2010). In contrast, training that provides detailed guidance on what and how teachers should teach has proven to be effective in enhancing the skills of low-performing students (Murnane & Ganimian 2014). For example, a scripted literacy program in Mumbai which provided storybooks, flashcards and a child library, as well as instructions for teachers specifying the activities in which these should be used and when, had positive effects on child literacy (He, Linden, & MacLeod 2009).

This highlights the fact that the large improvements in student learning produced by appropriate teacher training may be in part driven by a large degree of overlap with other interventions, because many of the

[13] Here effectiveness is defined in terms of improving student test scores in math and language. Several of these programs were found to improve children's computing skills, but without improvements in school achievement. Moreover, while these programs may improve computing skills for the specific computers or laptops provided, evidence from Peru suggests that this may not transfer to an improvement in more general computing skills (Beuermann et al. 2013; Murnane & Ganimian 2014).

[14] McEwan and Conn may not have precisely comparable standardized estimates since they control for different moderators in their regressions.

successful instructional interventions were coupled with teacher training in how to employ the new method in the classroom (McEwan 2014). For example, a related intervention providing flashcards to teach children English in India improved test scores by much more when it was implemented through a teacher training program than when it was introduced externally without preparing teachers (He, Linden, & MacLeod 2008).

Moreover, with regards to variation within the category of teacher training, one-time in-service trainings at a central location, typical of many teacher training interventions, are not those found to be highly effective. However, Conn (2014) finds pedagogical interventions involving long-term teacher mentoring or in-school teacher coaching to produce a sizeable (albeit not always significant) effect on student learning, at 0.25 standard deviations.[15] An example is the "Read, Educate, and Develop" (or READ) program in rural South Africa evaluated by Sailors et al. (2010), which provides students with high quality books relevant to their lives, and teachers with training on strategies to integrate these books into their lesson plans. This training includes demonstration lessons by READ mentors, monthly coaching and monitoring visits followed by one-on-one reflection sessions, and after-school workshops for both teachers and school administrators. The program had highly significant impacts on a range of reading measures, albeit with a quasi-experimental design. Overall, of the evaluations of programs with ongoing teacher training elements which Conn reviews, all four show statistically significant improvements in student literacy (Brooker et al. 2013; Lucas et al. 2014; Sailors et al. 2010; Spratt et al. 2013), as well as numeracy when it is tested (Lucas et al. 2014).

Other examples of interventions combining instructional methods with teacher training include a combination of student reading groups and in-school supervisors to provide guidance to group leaders in Chile (Cabezas, Cuesta, & Gallego 2012); a remedial education program in India, which gives local contract teachers two weeks of initial training followed by reinforcement throughout the school year (Banerjee et al. 2007); a program targeting early reading skills in Mali, which offers lesson plans and accompanying instruction materials, together with training, support visits, and grading of teacher guides and student workbooks (Friedman, Gerard, & Ralaingita 2010); and an early grade reading instruction program in Kenya and Uganda which provides schools with materials and trains teachers in the use of the instructional method (local-language materials) and in learning assessment, as well as providing them with regular mentoring (Lucas et al. 2014).

Glewwe et al.'s (2014) finding that teachers' knowledge of the subjects they teach increases student learning also implicitly supports teacher training interventions which effectively boost such knowledge. Kremer, Brannen, & Glennerster (2013) and Krishnaratne, White, & Carpenter (2013) have less to say about teacher training. This is explained in part by composition and in part by categorization. Some of the studies driving the large (and significant) positive effect for teacher training interventions in McEwan's sample appear in only one or two of the other reviews, and in one case in none of the others.[16]

[15] As Conn reports, with 4 studies the sample size does not allow estimation of a reliable p-value. But as suggestive evidence, the coefficient divided by the standard error yields a t-statistic of 1.87, which is normally considered significant with between 90 and 95 percent confidence.

[16] This is an early reading program in Mali (Friedman, Gerard, & Ralaingita 2010).

Furthermore, Krishnaratne, White, & Carpenter (2013) review a number of training interventions, but they have no specific category for teacher training and instead code all interventions that have training along with pedagogical materials (e.g., guides) under the broad umbrella of materials provision.

4.3 Accountability-boosting interventions

The intervention category with the third highest degree of overlap in support across the sample of reviews is that which we broadly term accountability-boosting interventions. These include two intervention sub-categories: (i) teacher performance incentives and (ii) contract teachers. McEwan (2014) estimates a mean effect of performance incentives of 0.09 (significant with 95 percent confidence), driven mostly by teachers, but the effectiveness of several approaches to improving such incentives varies greatly across studies (Kremer, Brannen, & Glennerster 2013). While two experiments in India (Muralidharan & Sundararaman 2011; Duflo, Hanna, & Ryan 2012) have shown teacher performance incentives to increase student learning, teachers in a Kenyan program responded primarily by teaching to the test (Glewwe et al., 2010). This confirms that teachers adjust their behavior in response to incentives, and it also raises questions about how best to design such incentives so as to maximize learning while minimizing strategic responses (McEwan 2014). McEwan (2014) also finds a mean effect size of employing contract or volunteer teachers of 0.10 standard deviations (significant with 99 percent confidence), highlighting that treatments that rely on contracted local teachers rather than volunteers are more likely to improve learning, presumably due to the relative accountability benefits that this provides. Studies in Kenya (Duflo, Dupas, & Kremer 2012) and India (Banerjee et al. 2007) both found improvements in test scores from supplementing civil-service teachers with locally hired teachers on short-term contracts. McEwan (2014) notes that the effective use of contract teachers is often accompanied by smaller class sizes (Bold et al., 2013; Duflo, Dupas, & Kremer 2012; Muralidharan & Sundararaman, 2010), and that the effects of the two cannot always be separated easily.

Murnane & Ganimian (2014) further explain some of the variation in the success of these interventions by their observation that low-skilled teachers need specific guidance – or “scaffolding” – to reach minimally acceptable levels of instruction. Because performance incentives improve effort, teachers need basic skills in order for greater effort to result in increased learning.

4.4 What does not work to improve student learning?

Having accounted for different definitions of intervention categories, we also observe overlap in conclusions regarding what does not work. Three of the six reviews explicitly highlight that health interventions (such as deworming or nutritional supplements) and cost-reducing interventions (such as fee reductions or monetary grants) are the least effective programs at improving student learning outcomes as measured by test scores, and none of the other reviews find them to be effective. There is substantial evidence that these interventions can effectively increase school enrollment and attendance, but not reading and math scores; as such, an integral education improvement program may couple these kinds of programs to boost access with the kinds of programs proven to improve learning. Note again that this conclusion is in part driven by the definition of learning as test scores in language and math in some of the reviews; Conn (2014) finds that health interventions do significantly improve students' attention and memory.[17] However, if children are more attentive to or better at remembering material that is poorly taught or poorly targeted to their learning level, the cognitive improvements may not translate into academic learning gains. Thus, if the goal is to improve student test scores, these programs are less likely to be effective.

5. Discussion

This paper demonstrates that systematic reviews may in fact fall far short of exhaustive coverage and – as a result – reach varying and sometimes divergent conclusions. Authors also make judgments as to how to characterize the studies they include, which may further drive differing conclusions. The least systematic form of analysis, the narrative review, can incorporate the largest number of studies but requires non-scientific tallying and weighting across studies, and is the most susceptible to influence by authors' prior beliefs. The most systematic form of analysis, the meta-analysis, may limit the included studies because of stringent requirements on the data reported in order compute strictly comparable effect sizes, and it may fail to illuminate the mechanisms behind the most effective interventions. Each method has flaws which keep it from being both systematic and exhaustive.

Nonetheless, these systematic reviews can effectively identify interventions that work well, even if they cannot convincingly identify what works best. For example, one of the key lessons from Murnane & Ganimian (2014) is that providing information about school quality and returns to schooling generally improves student attainment and achievement. This finding is mentioned in some of the other reviews, but it is not highlighted because of positive but lower average effect size. [18] Likewise, Glewwe et al. (2014) recommend investments in desks, tables, and chairs. In both the case of Murnane & Ganimian and the case of Glewwe et al., these recommendations are based on studies demonstrating positive, significant

[17] Ozier (2014) – not included in any of the reviews – finds that a large-scale deworming intervention in Kenya significantly increased reasoning test scores among the younger siblings of program participants ten years after implementation, with the effect equaling between 0.5 and 0.8 years of schooling.

[18] Despite a lower effect size, providing information on the returns to schooling in Madagascar (Nguyen 2009) is one of the most cost-effective education interventions that has been evaluated using an RCT (Kremer, Brannen, & Glennerster 2013).

impact. They may be a good investment in some school systems; but given the partial coverage of each review, it would be difficult to claim conclusively that they are the very best investments.

A further limitation of these reviews extends from a limitation of most underlying studies: The reviews focus on effectiveness but say less about the cost-effectiveness of various intervention types, due to the fact that most of the studies they review do not report sufficiently detailed and comparable cost data (Evans and Popova 2014; McEwan 2014). Varying costs can lead certain interventions to have lower benefits but much higher benefit-per-dollar than others, and policy makers make investment decisions based on costs as well as impacts. Kremer, Brannen, & Glennerster (2013) do provide cost-effectiveness results for a subsample of 18 studies. They find pedagogical interventions that match teaching to students' learning levels, contract teachers, and the provision of earnings information to be the most cost-effective. Informing the expensive end of the spectrum, McEwan (2014) combines his effect sizes with Kremer, Brannen, & Glennerster's (2013) cost estimates for intersecting studies to find that interventions focusing on computer-assisted learning and class size reduction may be less cost-effective than others. However, these are based on a small sample (less than ten percent) of the 227 learning studies included in this review; much additional work is needed.

Similarly, the reviewers acknowledge that – due again to the underlying studies - these reviews focus largely on short-term learning impacts. For example, McEwan (2014) highlights that for his sample of studies, the average follow-up is conducted after 9-13 months of program exposure, with only about 10 percent of follow-ups occurring at least one month after the conclusion of the intervention. Across low- and high-income countries, it has been observed that educational gains are sometimes not sustained over time (Andrabi et al. 2011; Jacob, Lefgren, & Sims 2010; Evans, Kremer, & Ngatia 2014). Thus, a clear shortcoming of this literature is its inability to inform the trajectory of longer-term learning impacts.

Future reviews will benefit from combining methodologies, for example performing meta-analysis – which allows a highly systematic analysis – accompanied with narrative review – which can explore heterogeneity within categories and the apparent mechanisms behind effective programs. Furthermore, using narrative review will allow the inclusion of studies that are excluded from meta-analyses. Given the high observed level of heterogeneity within classes of interventions, the most useful reviews are likely to use low levels of aggregation, identifying specific characteristics of interventions that are effective rather than broad classes of interventions. Future reviews will also be most useful if they are careful to search out unpublished studies: Less than two-thirds of studies included in the six reviews were published journal articles.

Taken together, the reviews do identify certain key messages: Both student learning interventions and teacher training interventions will be most effective when tailored to the student or teacher involved. Pedagogical interventions must change students' learning experiences and be adapted to individual student learning levels. Teacher training may be most effective when it is repeated and linked to a specific pedagogical method or tool. Increasing accountability can also improve student learning.

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Tables & Figures

Table 1: Pros and Cons of Different Review Types

	Narrative review	Meta-analysis	Vote counting
Summary	Examines the evidence qualitatively, usually discussing study by study, and then infers conclusions	Converts the results of all the included studies to standardized point estimates and then pools the estimates within a category of interventions to estimate the average effect of that category	Shows the pattern of significant and insignificant positive and negative impacts across categories of studies and draws inferences from that
Pros	• Most able to reflect on nuance within categories and draw conclusions from it • Can incorporate all relevant studies (not limited by particular statistics reported) • Often carried out by a recognized expert in the field	• Incorporates the data that vote counting excludes (e.g., effect size) • Increases statistical power by pooling across smaller studies • Allows controls for the quality of studies or other moderating factors	• Can incorporate all relevant studies (not limited by particular statistics reported) • Effectively captures patterns of statistical significance • Effectively captures the amount of evidence (i.e., number of studies) for a given class of interventions • Transparent
Cons	• Relies on a subjective weighting of the evidence by the reviewer, which may become less reliable as the number of studies reviewed increases • Not transparent if not all reviewed studies are reported • Labor intensive	• Studies that fail to report certain elements of underlying data may be excluded, despite being of high quality • Does not explore the mechanisms behind effective interventions • Labor intensive	• Ignores sample size and effect size, and so may overemphasize small significant effects at the expense of large effects that narrowly miss the significance cut-off • Can yield misleading results if some studies are underpowered

Table 2: Distribution of Review by Review Type

Narrative Review	Meta-Analysis	Vote Counting
Kremer, Brannen, & Glennerster (2013)	Conn (2014)	Glewwe et al. (2014)
Murnane & Ganimian (2014)	McEwan (2014)	
	Krishnaratne, White, & Carpenter (2013)	

Table 3: Reviews and Their Composition

Review	Learning studies reviewed (Total studies reviewed)	Inclusion criteria (in brief)
Conn (2014)	56 (56)	Any formal education level Learning outcomes RCT & quasi-experimental Sub-Saharan Africa 1980-2013
Glewwe et al. (2014)	67 (79)	Primary & secondary school Learning or access outcomes RCT and quasi-experimental Low & middle income countries 1990-2010
Kremer, Brannen, & Glennerster (2013)	30 (34)	Primary school Learning or access outcomes RCT only Low & middle income countries
Krishnaratne, White, & Carpenter (2013)	43 (76)	Primary & secondary school Access outcomes RCT & quasi-experimental Low & middle income countries 1990-2009
McEwan (2014)	66 (66)	Primary school Learning outcomes RCT only Low & middle income countries
Murnane & Ganimian (2014)	92 (130)	Primary & secondary school Learning or access outcomes RCT & natural experiments (no matching or fixed effects) Low & middle income countries
Total learning studies reviewed	227	
Total studies reviewed	301	

Notes: RCT stands for randomized controlled trial. Learning outcomes are scores in language or reading (in local language or English), mathematics, science, cognitive outcomes, or a composite assessment including any of these. Notably, learning outcomes do not include assessments of computer skills. Access outcomes include enrollment, attendance, and years of schooling. Note that we describe inclusion and not exclusion criteria; for example, where the inclusion criterion is access (learning) outcomes only, this means that only studies that have at least one access (learning) outcome are included in the review, although studies may include other outcomes in addition.

Table 4: Number of Learning Studies by Region

	Number of studies evaluating learning interventions
East Asia and Pacific	42
Of which China	24
Europe and Central Asia	5
Latin America and the Caribbean	57
Of which Chile	10
Middle East and North Africa	4
South Asia	36
Of which India	20
Sub-Saharan Africa	77
Of which Kenya	26
Low and Middle Income	204
High Income	26
Total	227

Notes: This table includes several studies that are multi-country (or multi-income level) in nature, so the sum across regions (and income levels) exceeds the total number of studies.

Table 5: Proportion of Learning Studies Included in each Review by Region

	Number of studies evaluating learning interventions						
	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014	All reviews
East Asia and Pacific	0%	22%	7%	21%	29%	13%	19%
Europe and Central Asia	0%	3%	0%	2%	0%	2%	2%
Latin America and the Caribbean	0%	28%	10%	26%	18%	30%	25%
Middle East and North Africa	0%	0%	0%	0%	0%	4%	2%
South Asia	4%	19%	33%	16%	21%	22%	16%
Sub-Saharan Africa	100%	21%	40%	35%	33%	27%	34%
Low and Middle Income	100%	90%	90%	98%	98%	84%	90%
High Income	0%	13%	10%	2%	3%	16%	11%
Total number of studies	56	67	30	43	66	92	227

Note: A small number of studies include results from countries from more than one region. We include studies in the count for all regions for which they cover at least one country. As such, the sum of percentages of studies by region within a given review may exceed 100%.

Table 6: Distribution of Learning Studies Included in each Review by Publication Status

	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014	Studies in this category across reviews
Journal articles with learning outcomes							
Number of studies	34	62	18	23	32	46	142
As percentage of all studies with LO in this review	61%	93%	60%	53%	48%	50%	63%
Working papers with learning outcomes							
Number of studies	15	5	11	16	33	44	73
As percentage of all studies with LO in this review	27%	7%	37%	37%	50%	48%	32%
Reports with learning outcomes							
Number of studies	7	0	1	4	1	2	12
As percentage of all studies with LO in this review	13%	0%	3%	9%	2%	2%	5%
Total							227

Note: LO stands for learning outcomes.

Table 7: Main Conclusions of Reviews on the Most and Least Effective Interventions for Improving Student Learning

	Main conclusions	
Study	**Most effective**	**Least effective**
Conn (2014)	Pedagogical interventions	Health interventions[19]
	Student incentives	
Glewwe et al. (2014)	Desks, tables, and chairs	
	Teacher subject knowledge	
	Teacher presence	
Kremer, Brannen, & Glennerster (2013)	Pedagogical interventions to match teaching to students' learning	Cost-reducing interventions
	Accountability	Health interventions
	Incentives	Information interventions
Krishnaratne, White, & Carpenter (2013)	Materials	
McEwan (2014)	Computers or instructional technology	Monetary grants
	Teacher training	Deworming treatments
	Smaller classes, smaller learning groups within classes, or ability grouping	
	Contract or volunteer teachers	
	Student and teacher performance incentives	
	Instructional materials	
Murnane & Ganimian (2014)	Providing information about school quality and returns to schooling	Reducing the costs of going to school
	Teacher incentives (in very low performance settings)	Alternatives to traditional public schools
	Specific guidance for low-skilled teachers to reach minimally acceptable levels of instruction	Resources (unless they change children's daily experiences at school)

[19] Conn (2014) finds large health effects on cognitive assessments (e.g., memory or attention), but low effects on student learning assessments.

Table 8: Inclusion of Learning Studies across Reviews

	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014	Studies in this category across reviews
Studies with Learning Outcomes							
Number of studies in this review	56	67	30	43	66	92	227
As percentage of all studies with learning outcomes	25%	30%	13%	19%	29%	41%	
RCTs with Learning Outcomes							
Number of studies in this review	44	12	30	33	66	68	134
As percentage of all RCTs with learning outcomes	33%	9%	22%	25%	49%	51%	
RCTs with Learning Outcomes, Primary Level, 1990-2010							
Number of studies in this review	33	12	28	26	64	53	107
As percentage of all RCTs with LO, primary, 1990-2010	31%	11%	26%	24%	60%	50%	
RCTs with Learning Outcomes, Primary Level, 1990-2010, SSA							
Number of studies in this review	33	4	11	11	22	19	42
As percentage of all RCTs with LO, primary, 1990-2010, SSA	79%	10%	26%	26%	52%	45%	

Note: LO stands for learning outcomes; SSA stands for Sub-Saharan Africa. Studies are coded as SSA if they include learning outcomes for at least one country in Sub-Saharan Africa.

Table 9: Categorization of Studies across Reviews

Study	How it is categorized in: Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014	Total citations
Glewwe, Kremer, and Moulin (2009)	School supplies	Textbooks	Textbooks	Materials	Instructional materials	Textbooks	6
Glewwe et al. (2004)	School supplies	Flipcharts	Flipcharts	Materials	Instructional materials	Flipcharts	6
Kremer, Miguel, and Thornton (2009)	Student incentives	Merit-based scholarships	Merit scholarships	School fees	Performance incentives	Cash transfers	6
Banerjee et al. (2007)	-	Computers & electronic games	Reducing class size/Computer-assisted learning/Contract teachers	Materials	Instructional materials/Computers or technology/Teacher training/Class size or composition/Contract or volunteer teachers	Computer-assisted learning	5
Barrera-Osorio and Linden (2009)	-	Computers & electronic games	-	Materials/School-based management	Computers or teachnology/Teacher training	Computers in schools	5
Glewwe, Ilias, and Kremer (2010)	Teacher incentives	-	Incentivising teacher presence	Additional teaching resources	Performance incentives	Pay for performance	5
Nguyen (2009)	Information for accountability	-	Providing earnings information	Providing information	Information	Information on returns to education	5
Bold et al. (2013)	Teacher incentives	-	Contract teachers	-	Class size or composition /Contract or volunteer teachers	Contract teachers	4
Duflo, Hanna, and Ryan (2012)	-	-	Incentivising teacher presence	Additional teaching resources	Performance incentives	Pay for attendance	4
Kremer, Duflo, and Dupas (2011)	Class size & composition	-	Contract teachers/Streaming	-	Class size or composition	Class size	4
Lassibille et al. (2010)	Management intervention	-	-	School-based management	Information	Capacity-building on school management	4
Miguel and Kremer (2004)	Health intervention	-	-	Health intervention	Deworming drugs	Medications	4

Notes: This includes all 12 studies that appear in four, five, or six of the reviews.

Table 10: How many of the Studies in One Review's Recommended Category of Intervention are Included in Other Reviews?

	Percentage of studies included in review					
	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014
Conn 2014 - Pedagogical interventions	--	6%	0%	6%	6%	18%
Kremer, Brannen, & Glennerster 2013 - Matching teaching to students' learning	50%	50%	--	50%	100%	50%
Krishnaratne, White, & Carpenter 2013 - Materials provision	17%	67%	50%	--	100%	67%
McEwan 2014 - Computers or instructional technology	0%	30%	30%	40%	--	70%
Murnane & Ganimian 2014 - Information provision	11%	0%	11%	33%	33%	--

Table 11: How many of the Studies in One Review's Recommended Category of Intervention are Included in Other Reviews? – RCTs only

	Percentage of RCT studies included in review					
	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014
Conn 2014 - Pedagogical interventions	--	0%	0%	6%	6%	12%
Kremer, Brannen, & Glennerster 2013 - Matching teaching to students' learning	50%	50%	--	50%	100%	50%
Krishnaratne, White, & Carpenter 2013 - Materials provision	17%	67%	50%	--	100%	67%
McEwan 2014 - Computers or instructional technology	0%	30%	30%	40%	--	70%
Murnane & Ganimian 2014 - Information provision	11%	0%	11%	33%	33%	--

Table 12: Composition analysis – Conn's (2014) sample of pedagogical studies

	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014	Murnane & Ganimian 2014
Abdu-Raheem (2012) - Nigeria	-	-	-	-	-
Ajaja and Eravwoke (2010) - Nigeria	-	-	-	-	-
Bimbola and Daniel (2010) - Nigeria	-	-	-	-	-
Brooker et al. (2013) - Kenya	-	-	Health intervention	-	-
Githau and Nyabwa (2008) - Kenya	-	-	-	-	-
Kiboss (2012) - Kenya	-	-	-	-	-
Korsah et al. (2010) - Ghana	-	-	-	-	-
Louw, Muller, and Tredoux (2008) - South Africa	*Missing code*	-	-	-	-
Lucas et al. (forthcoming) - Kenya and Uganda	-	-	-	Instructional materials/ Teacher training	Scripted lessons
Lucas and Mbiti (2012) - Kenya	-	-	-	-	Fee abolition
Nwagbo (2006) - Nigeria	-	-	-	-	-
Piper and Korda (2011) - Liberia	-	-	-	-	Feedback for teachers
Piper (2009) - South Africa	-	-	-	-	-
Sailors et al. (2010) - South Africa	-	-	-	-	-
Spratt, King, and Bulat (2013) - Mali	-	-	-	-	-
Van Staden (2011) - South Africa	-	-	-	-	-
Wachanga and Mwangi (2004) - Kenya	-	-	-	-	-
Percentage of studies included in review	6%	0%	6%	6%	18%
Percentage of RCT studies included in review	0%	0%	6%	6%	12%

Table 13: Composition analysis – Kremer, Brannen, & Glennerster's (2013) sample of studies on pedagogical interventions to match teaching to students' learning

	Conn 2014	**Glewwe et al. 2014**	**Krishnaratne, White, & Carpenter 2013**	**McEwan 2014**	**Murnane & Ganimian 2014**
Banerjee et al. (2007) – India	-	Computers & electronic games	Materials	Instructional materials/ Teacher training/Class size or composition/Contract or volunteer teachers	Computer-assisted learning
Kremer, Duflo, & Dupas (2011) - Kenya	Class size & composition	-	-	Class size or composition	Class size
Percentage of studies included in review	50%	50%	50%	100%	50%
Percentage of RCT studies included in review	50%	50%	50%	100%	50%

Table 14: Composition analysis – Krishnaratne, White, & Carpenter's (2013) sample of materials provision studies

	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	McEwan 2014	Murnane & Ganimian 2014
Banerjee et al. (2007) - India	-	Computers & electronic games	Computer-assisted learning	Instructional materials/ Teacher training/Class size or composition/Contract or volunteer teachers	Computer-assisted learning
Barrera-Osorio (2009) - Colombia	-	Computers & electronic games	Technology	Computers or technology	Computers in schools
Glewwe et al. (2004) - Kenya	School supplies	Flipcharts	Flipcharts	Instructional materials	Flipcharts
He et al. (2008) - India	-	-	-	Instructional materials/Computers or technology	Scripted lessons
Lai et al. (2012) - China	-	-	-	Computers or technology/Teacher training	-
Tan et al. (1999) - Philippines	-	Textbooks/School meals	-	Instructional materials/ Teacher training/ Treatments with food, beverages, and/or micronutrients/ Treatments that modify school management or supervision	-
Percentage of studies included in review	17%	67%	50%	100%	67%
Percentage of RCT studies included in review	17%	67%	50%	100%	67%

Table 15: Composition analysis – McEwan's (2014) sample of technology studies

	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	Murnane & Ganimian 2014
Banerjee et al. (2007) - India	-	Computers & electronic games	Computer-assisted learning	Materials	Computer-assisted learning
Barrera-Osorio and Linden (2009) - Colombia	-	Computers & electronic games	Technology	Materials	Computers in schools
Carillo, Onafa, and Ponce (2010) - Ecuador	-	-	-	-	Computer-assisted learning
Cristia et al. (2012) - Peru	-	-	Technology	-	Computers in schools
He, Linden, and Macleod (2008) - India	-	-	-	Additional teaching resources	Scripted lessons
Lai et al. (2012) - China	-	-	-	Materials	-
Lai et al. (2012) - China	-	-	-	-	-
Linden (2008) - India	-	Computers & electronic games	-	-	Computer-assisted learning
Mo et al. (2012) -China	-	-	-	-	Computer-assisted learning
Mo et al. (2013) - China	-	-	-	-	-
Percentage of studies included in review	0%	30%	30%	40%	70%
Percentage of RCT studies included in review	0%	30%	30%	40%	70%

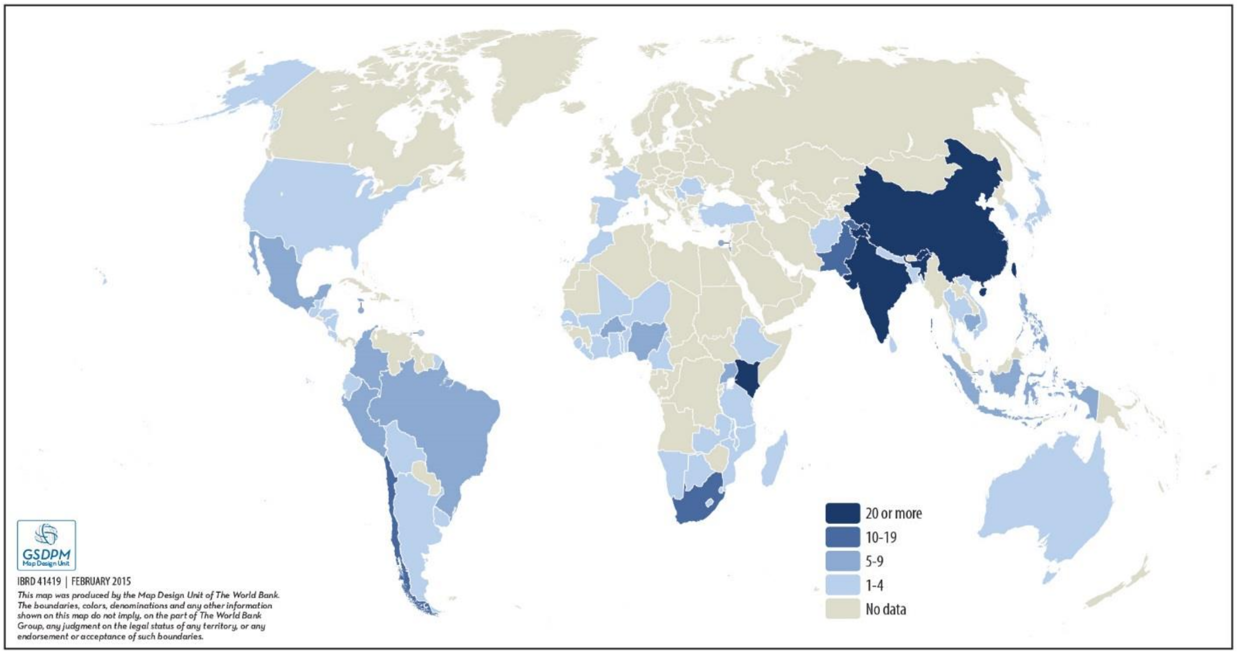
Table 16: Composition analysis – Murnane & Ganimian's (2014) sample of information provision studies

	Conn 2014	Glewwe et al. 2014	Kremer, Brannen, & Glennerster 2013	Krishnaratne, White, & Carpenter 2013	McEwan 2014
Andrabi et al. (2009) - Pakistan	-	-	-	Providing information	Informational treatments
Camargo et al. (2011) - Brazil	-	-	-	-	-
Dinkelman and Martínez (2013) - Chile	-	-	-	-	-
Hicks et al. (2013) - Kenya	-	-	-	-	-
Jensen (2010) - Dominican Republic	-	-	Providing earnings information	Providing information	-
Jensen (2010a) - India	-	-	-	-	-
Loyalka et al. (2013) - China	-	-	-	-	Informational treatments
Mizala and Urquiola (2013) - Chile	-	-	-	-	-
Nguyen (2009) - Madagascar	Information provision	-	Providing earnings information	Providing information	Informational treatments
Percentage of studies included in review	11%	0%	11%	33%	33%
Percentage of RCT studies included in review	11%	0%	11%	33%	33%

Table 17: Variance within versus across McEwan's (2014) intervention categories

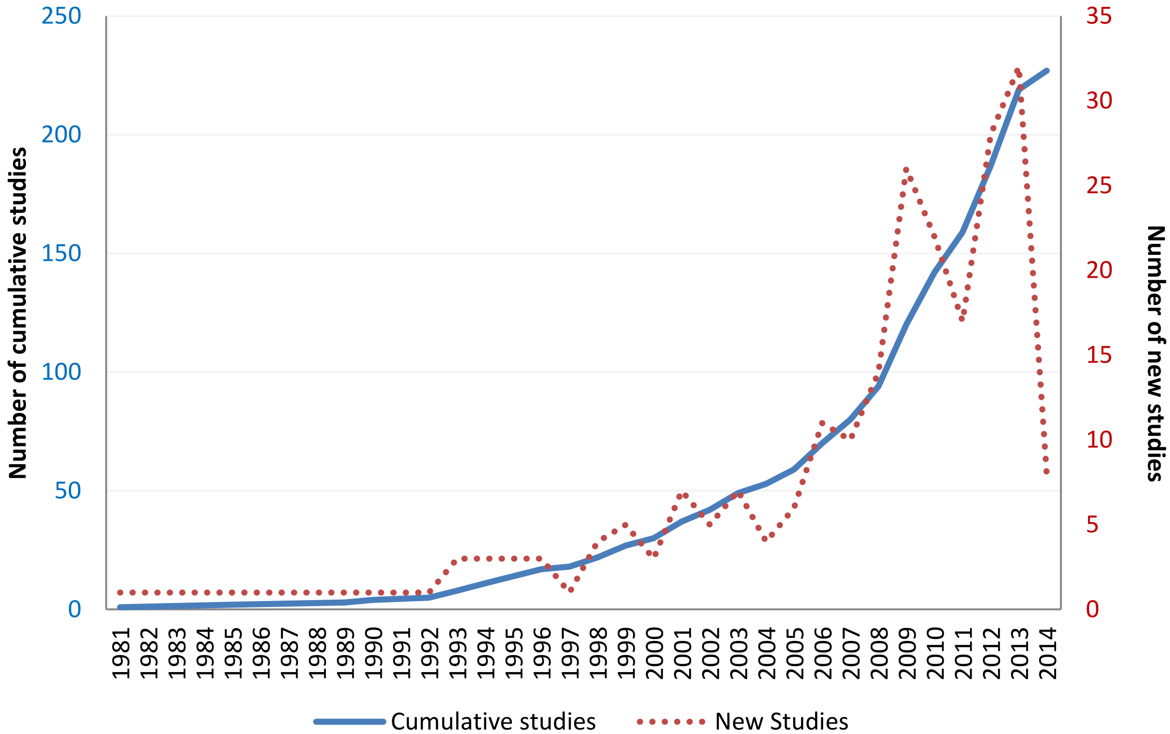
Category	In category		Not in category		Total		More within category variation?
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Teacher training	0.171	0.225	0.067	0.156	0.097	0.184	Yes
Computers or technology	0.200	0.309	0.082	0.154	0.097	0.184	Yes
Instructional materials	0.107	0.160	0.093	0.192	0.097	0.184	No
Deworming drugs	0.044	0.188	0.102	0.183	0.097	0.184	Yes
Food, beverages, and/or micronutrients	0.066	0.188	0.102	0.183	0.097	0.184	Yes
Contract or volunteer teachers	0.117	0.093	0.093	0.196	0.097	0.184	No
Monetary grants	-0.005	0.098	0.103	0.186	0.097	0.184	No
Class size or composition	0.132	0.083	0.092	0.194	0.097	0.184	No
School management or supervision	0.118	0.188	0.094	0.184	0.097	0.184	Yes
Student/teacher performance incentives	0.102	0.106	0.096	0.191	0.097	0.184	No
Informational treatments	0.058	0.095	0.102	0.192	0.097	0.184	No

Figure 1: Number of studies evaluating learning interventions by country



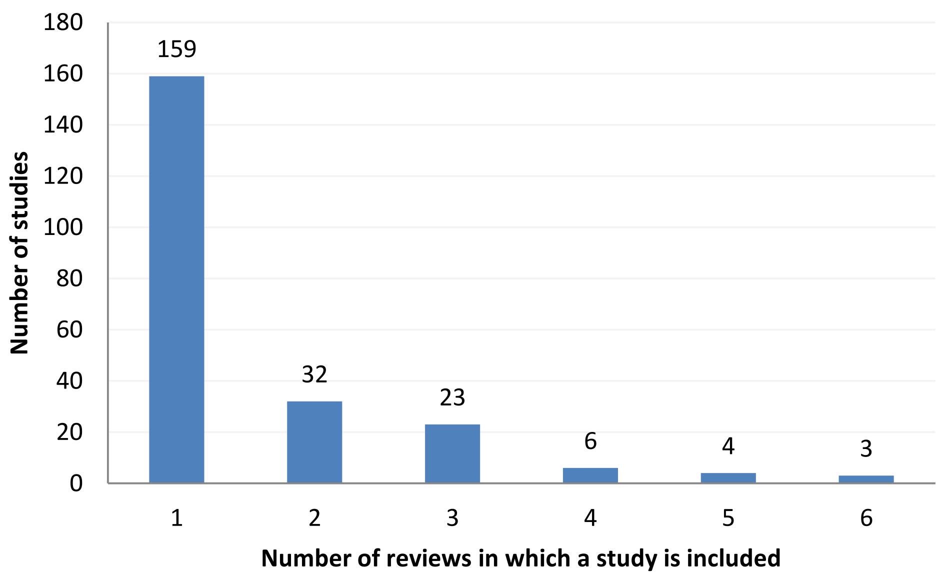
Note: This map displays the geographic distribution of the learning studies included in these reviews. The evidence from high-income countries shown here is not reflective of the actual body of evidence from these countries, as the reviews included focus on lower- and middle-income countries, occasionally using high-income countries as comparators. Five studies, which do not report any country-specific results, are excluded from the map, leaving 222 learning studies presented.

Figure 2: Distribution of Learning Studies over Time



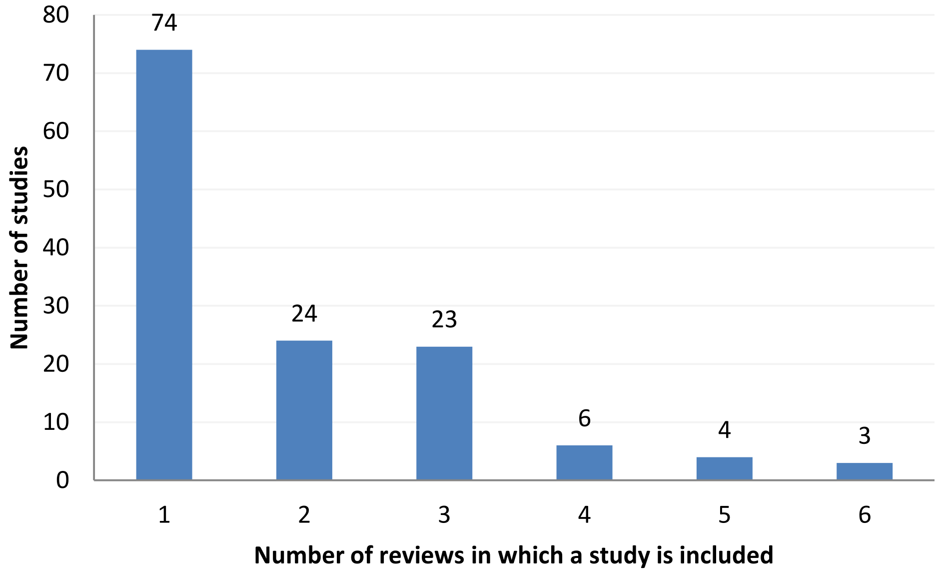
Note: This includes the 227 studies with learning outcomes reviewed across the 6 reviews, ordered by publication date of the latest version.

Figure 3: Distribution of Learning Studies across Systematic Reviews



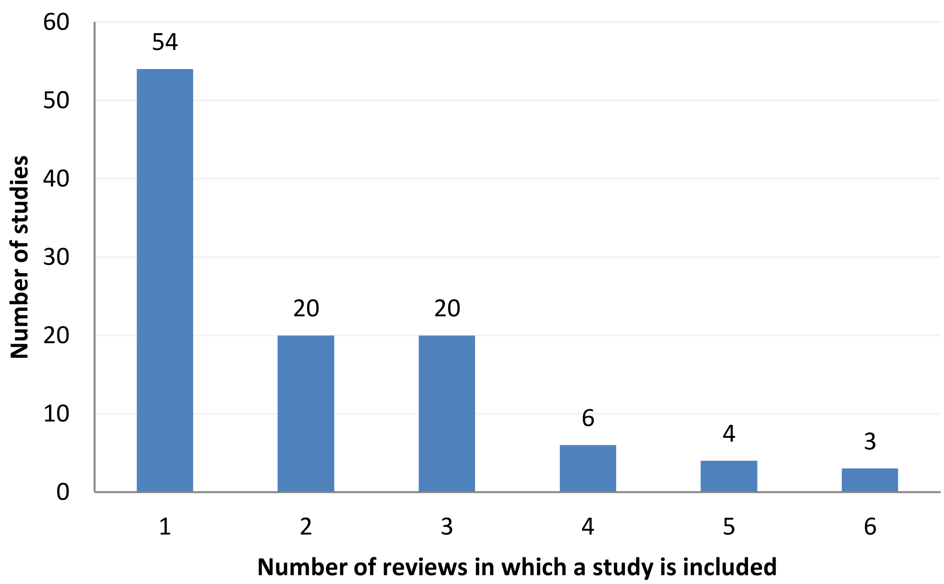
Note: The total number of learning studies is 227.

Figure 4: Distribution of Learning RCTs across Systematic Reviews



Note: The total number of learning RCTs is 134.

Figure 5: Distribution Learning RCTs at Primary Level from 1990 to 2010, across Systematic Reviews



Note: The total number RCTs evaluating learning outcomes of interventions at the primary level, published between 1990 and 2010 is 107.