Education Rigorous Literature Review

Literacy, Foundation Learning and Assessment in Developing Countries

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Abbreviations

ASER	Annual Status of Education Report
biL	Biliteracy
DFID	Department for International Development (UK)
DHS	Demographic and Health Survey
EGMA	Early Grades Mathematics Assessment
EGRA	Early Grades Reading Assessment
L1	Home language
L2	Second or other language
LoI	Language of instruction
MI	Medium of instruction
MRC	Madrasa Resource Centre
NGO	Non-governmental organisation
OPHI	Oxford Poverty and Human Development Initiative
QED	Quasi-experimental design
Qual.	Qualitative
RCT	Randomised controlled trial
SES	Socio-economic status
ToC	Theory of change

Executive summary

Developing countries face distinct challenges in providing access to quality education. Educational provision also varies markedly in terms of teacher training, teaching and learning resources, school attendance, and motivation of parents, teachers and children for schooling. Against this backdrop, we consider the available evidence on foundation learning and literacy in order to identify key components for intervention that are appropriate to specific cultural and linguistic contexts. A fundamental assumption is that in order to increase the educational attainments of children, it is critical to put in place high-quality teacher education; however this is beyond the scope of the current review.

The review was informed by research conducted in economically developed countries, but the focus of the narrative review was on literature from developing countries (low- and lower-middle income countries), published from 1990 to January 2013. We chose 1990 as the cut-off year because this was the year of the Jomtein Summit and marked the UN Declaration of Education for All. All papers were appraised for methodological quality and cultural sensitivity, and we included only those studies rated as of high and moderate quality in the narrative review.

The review was commissioned to address issues pertaining to foundation learning and literacy. We therefore included evidence on language and literacy learning from early childhood to Grade 8 (approximately 3-13 years), when the ability to read with understanding should be in place. We also decided to include mathematical reasoning and numeracy learning up to Grade 2 (approximately 3-8 years) as an example of a foundation skill critical to the development of numerical and scientific thinking. In conducting the review, we considered within-child factors, including cognitive and language skills, and contextual factors including home language and literacy environment, community practices and quality of opportunity as well as the social stratifiers and economic drivers that influence non-enrolment, poor attendance, and dropout. Finally, we included a rigorous evaluation of interventions.

Main findings

1. Learning to read and write builds on a child's oral language skills. Children also thrive better in the domain of literacy if they come to school with a well-established concept of print. Likewise, numeracy development demands language proficiency as a support for numerical operations, and more particularly, problem solving; more generally, language is the vehicle of instruction. It follows that children who enter school with poor oral language are at high risk of educational failure. Our review shows that this is as clear in developing countries as in economically developed countries, particularly because in these settings, so many children do not speak the language of the classroom. While the focus of much research has been on reading (and to a much lesser extent on writing and mathematics), the review highlights the importance of a focus on oral (spoken) language proficiency.
2. Both child-level and school-level factors affect attainments, but the relative impact of the two sources of variability is difficult to quantify given the extant research.
3. Whatever the language of literacy, solid foundations in oral language, particularly vocabulary and sentence comprehension, are essential prerequisites for literacy development in that language. The crucial point is that the child should have sufficient mastery of vocabulary and syntax to enable inferences from text (be it literary text or problems posed in mathematics).
4. Despite the universal nature of many of the factors that predict individual differences in literacy, some predictors are stronger for some languages and

writing systems than others (e.g. syllable recognition for Kannada, phoneme recognition for Bahasa Indonesia, and morphological knowledge for Turkish). One implication of these findings is that good-quality assessments require psycholinguistic measures of skills that are *relevant* for the language of literacy instruction in developing countries; a simple translation (adaptation) of tasks can miss important information.

5. Studies in the current review confirm that poor language comprehension is an obstacle for reading comprehension, and even in instances where word recognition is high, reading comprehension may be poor. Although reading for meaning is the goal of learning to read, there has been relatively little attention to either reliable assessment of reading comprehension or inference making in developing countries.
6. The review provides a fairly consistent picture of the teaching of numeracy in the countries that have been studied. The emphasis is on relaying number facts, with considerable reliance on recitation and rote learning. There is comparative neglect of the teaching of number concepts and arithmetic strategies and very little attention is paid to embedding problem solving in familiar contexts. A major issue is the language of the classroom. This can be abstract and removed from everyday experience.
7. For many reasons, methods for rote and surface learning persist in low-income settings for teaching literacy and numeracy skills; although they are of undoubted value for promoting memory of facts, the evidence clearly indicates that they constrain learning if individual differences in the skills children bring to school are not taken into consideration. A major issue is that the methods are light on explanation and practical exercises. They do not make more explicit what is required for competency.
8. There are relatively few robust evaluations of the efficacy of interventions. A systematic review of randomised controlled trials revealed positive impacts of six different programmes for reading and/or numeracy. Arguably, an obvious next step is to roll these out in further field trials; however, it is important to recognise that in resource-poor settings, it may be relatively easy to bring about immediate gains, and unless there is better understanding of which aspects of these programmes *mediate* gains, their impact could be short-lived.
9. Consistent with findings from resource-rich countries, there was also moderate evidence of the efficacy of preschool enrichment programmes on foundation learning and emergent literacy skills. Our review also found some evidence that reading interventions with a phonological basis are effective. While programmes that target specific skills (e.g. phonological training, morphological training) and those that target broader skills (e.g. oral language proficiency, inference making) need to go together, the optimal intensity and duration of these is difficult to quantify given the extant research.
10. In addition, we believe that there are key messages to be learned from some of the research rated as low-to-moderate in quality in our review. Consideration might be given to trawling this body of work, in particular for examples of good practice which have been found acceptable by local communities and which therefore hold promise. More generally, there are many examples of local research which are valuable but not well documented and which therefore invite replication.

Implications for a theory of change model

Based on the review, a number of points of intervention can be identified which have the potential to bring about change in educational attainments:

- targeting the oral language skills known to underpin literacy development, most notably phonological awareness and comprehension of spoken language, in preschool

- the establishment of cognitive and language skills known to underpin the development of mathematical reasoning, most notably a logical approach to problem solving, knowing ways to count and the relations between numbers
- the establishment of skills that underpin the inference making that is necessary for reading comprehension, writing, mathematical reasoning and the next steps in education
- the integration of interventions with local cultural practices in order to avoid the tendency for 'Western' programmes to 'stamp out' indigenous methods and consequently reduce the engagement of children and their families.

Implications for monitoring children's attainments

In order to monitor children's attainments as well as the process of change, key areas for assessment of literacy and numeracy in the early grades are:

- phonological awareness (recognition of phonological units within words, such as syllables and phonemes)
- symbol knowledge (akshara and symbol blocks of the alphasyllabary, letters and symbols of the alphabet); written numbers; numerical symbols
- vocabulary knowledge (more- and less-frequent words, multi-morphemic words comprised of different meaning units such as prefixes, roots and suffixes; number words and ways to describe number operations)
- sentence comprehension (understanding of spoken and written sentences, and connections between sentences)
- assessment of 'real life' mathematics that is sensitive to children's intuitive reasoning, number sense and verbal number skills.

Key questions and issues

Based on gaps in the literature, key research questions and issues are:

Contextual factors

- What is the short- and long-term impact of mother tongue education and what are the moderating influences of classroom practices and home environment on learning outcomes?
- How can foundation learning and literacy development for vulnerable groups be supported best, especially children from low-income families in rural areas and, depending on the community and country, children with a gender disadvantage?

Within-child factors:

- What is the nature of interactions between within-child factors and attainments in different learning environments?
- How can language and literacy skills in the home language best be assessed to examine transfer to the language of instruction?

Assessments

- The development of sensitive and reliable tools for assessment of children's learning, particularly for oral language, reading comprehension, inference making and mathematical problem solving.
- The development of teacher-administered tools and observational methods attuned to children's learning needs and learning profiles.
- Development of measures for learning environments in the classroom and at home, both for language and literacy development and for mathematical reasoning and numeracy learning.

Interventions

- What are the outcomes of programmes developed to improve reading comprehension?
- What are the indicators of potential of small-scale innovations for large-scale rollout?
- What specific components of mother-tongue education make them more successful?
- What are the components of effective language-for-literacy interventions in multilingual classrooms?
- In what ways do social stratifiers and economic factors moderate the effects of interventions?
- What are the challenges for home intervention programmes where the language of instruction at school differs from the home language and the broader local-language context?
- What components of home environment best support the development of mathematical reasoning and numeracy in the early years?

More generally, the following issues must be addressed:

- the efficacy of teacher education
- the optimal intensity and duration for programmes that target specific skills (e.g. phonological training) and those that target broader skills (e.g. oral language proficiency)
- the nature of the teacher and supervisor supports necessary to ensure fidelity of implementation
- more sensitive measures to characterise teaching practices, parenting and home-tutoring support and child outcomes
- the costs involved and issues of value for money.

A research design of choice would be a multi-country randomised controlled trial (RCT). It would be important to have very good measures of school-level factors so they can be investigated in statistical analyses to examine the interactions between types of interventions and types of learning environments, and how children with different profiles of strengths and difficulties respond to the intervention.

1. Introduction

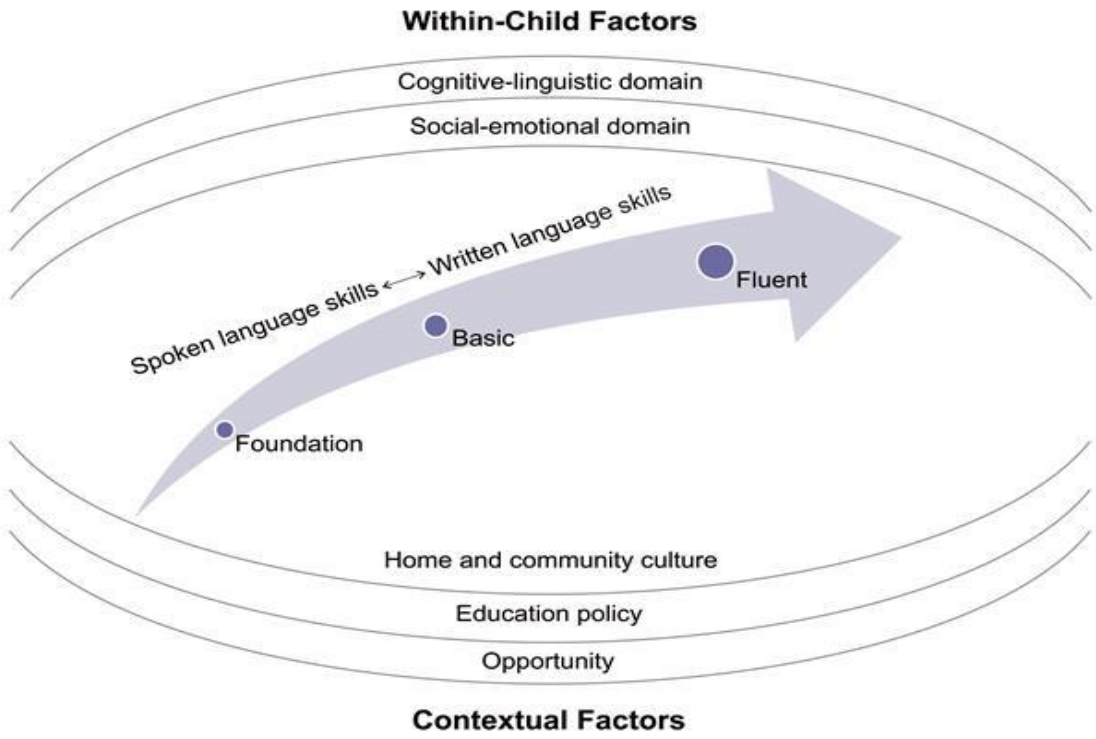
Developing countries differ widely in their history, linguistic and cultural heritages. In these countries, the challenges surrounding access to quality education, as well as health care, are considerable, especially for those living in rural and low-income communities. Moreover, educational provision varies markedly in terms of teacher training, teaching and learning resources, school attendance and motivation of parents, teachers and children for schooling. Against this backdrop, we consider the available evidence on foundation learning and literacy in order to identify key components of intervention that are universally appropriate, and the ways in which these must also be deeply embedded in specific cultural and linguistic contexts. This review does not specifically address the issue of teacher training, but it is clear that unless teachers are properly educated about the processes involved in the acquisition of foundation skills, they will be unable to develop, adapt and deliver appropriate curricula to ensure children's attainments.

We begin with a brief review of what is known about literacy and mathematical development as a backdrop to considering the acquisition of these skills in developing countries and the teaching practices that are prevalent. We then present theory of change models for literacy and mathematical learning, supported by theoretical understanding and empirical evidence from both the economically developed and developing countries. We focus on:

1. within-child factors that influence literacy and mathematical development
2. challenges in low-income settings, and when home and school languages differ
3. interventions for literacy and mathematical development
4. assessment of the component skills in literacy and mathematical learning.

For each, we consider child and contextual factors, as illustrated schematically in Figure 1.1.

Figure 1.1: Acquisition of literacy: child and context



On the strength of the evidence available, we conclude that **key targets** for intervention in foundation learning are**:**

1. the establishment of **oral language skills** known to underpin literacy development, most notably, phonological awareness and comprehension of spoken language
2. the establishment of **cognitive and language skills** known to underpin the development of mathematical reasoning, most notably a logical approach to problem solving, knowing how to count and the relations between numbers
3. the establishment of skills that underpin **inference making,** necessary for reading comprehension, writing, mathematical reasoning and the next steps in education.

We recognise that in the linguistically and culturally diverse contexts typical of developing countries, the conditions that enable successful delivery of an intervention may be particularly challenging to create. These conditions are at the outset influenced by a push for quantity (e.g. build more schools) as opposed to quality (e.g. improve teaching-learning), and the availability of appropriate curricula, textbooks and teacher training. While acknowledging each of these (among others) as enabling conditions, we propose a set of interventions that have theoretical underpinnings, and have the best support of evidence.

2. Aims, definitions and scope of the review

The broad aim of the review was to establish the level of evidence available regarding foundation learning and literacy in developing countries with their diverse languages and writing systems. For each domain of learning, we set out to synthesise what is known about foundation and basic skills, fluency and inferential understanding. Working definitions of these terms are given in Box 2.1.

Box 2.1: Definition of key terms

Foundation skills: the prerequisites for learning that children bring to school and that schooling builds on, e.g. concepts of print, letter knowledge, vocabulary and oral language; number sense, awareness about quantities, the relations between quantities, and concepts of numbers as one way to represent quantities and their relations.

Basic skills: those skills that enable a child to read simple texts (e.g. decode print and understand) or to perform simple mathematical reasoning and arithmetic (e.g. knowing counting routines, additive reasoning (+, −)).

Fluency: the development of automaticity such that basic reading/mathematical reasoning can be completed without conscious effort and in a timely manner. For example, reading for understanding without attention to decoding.

Inferential understanding: the ability to go beyond the literal; this is critical in reading for meaning and for mathematical reasoning/problem solving.

The focus of the review is on literature from low- and lower-middle-income countries based on the listing by the World Bank and OECD.[1] We have also included research into low-income communities in upper-middle-income countries. Our search targeted publications **from 1990 to January 2013**. We chose 1990 as the cut-off because this was the year of the Jomtein Summit and marked the UN Declaration of Education for All.

We have included in the review (a) reports of primary data arising from experimental methods or from observational studies using statistical, ethnographic or other qualitative-descriptive methods of analysis and (b) intervention studies employing randomised controlled trials (RCTs) or quasi-experimental designs (QEDs) with a sample size of above 32. We have excluded policy documents, opinion pieces and reviews.

All papers have been appraised for **methodological quality**. We rated studies as High (shown as ↑) when they demonstrated adherence to principles of appropriateness, rigour, validity and reliability, and demonstrated principles of conceptual framing, transparency and cogency.[2] Additionally, we have evaluated all intervention studies for **cultural sensitivity**; a study was rated as High when it demonstrated contextualisation and integration of local culture and resources, and demonstrated appropriate assessment and accounting of context-specific processes in interpretation of the results. Studies with some shortcomings were rated as Moderate (→), and those with several shortcomings were rated as Low (↓).[3, 4] We have included only those studies of **high and moderate quality** in the narrative review; we cite these in footnotes.

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[1] DAC list of ODA countries: http://www.oecd.org/dac/stats/historyofdaclistsofaidrecipientcountries.htm
[2] Based on DFID (2013)
[3] Wherever a paper of a team member was found eligible, quality appraisal was done by two others in the team. The details are as follows:

- Asfaha's papers (appraised by Chiat and Polisenska, Griffiths and Reeves for the Language and Literacy strands),
- Vagh's paper (appraised by Reeves and Nag for the Home Literacy Environment strand)
- Nag's papers (appraised by Chiat and Polisenska, Griffiths and Reeves, Snowling, Asfaha and Reeves for the Language, Literacy and QED strands respectively)
- Snowling's papers (appraised by Chiat and Polisenska, Griffiths and Reeves for the Language and Literacy strands).

[4] Quality appraisal of studies was quality assured within designs/strands; quality assurance between strands was moderated by Nag.

The review covers several thematic strands. Papers related to *within-child* factors have been reviewed under oral language, predictors and assessment of literacy and mathematical reasoning; those related to contextual factors under home literacy environment, teaching practices, economic drivers that influence non-enrolment and dropout, and social stratifiers; and those about interventions, by research design (RCTs, QEDs). The review included evidence on:

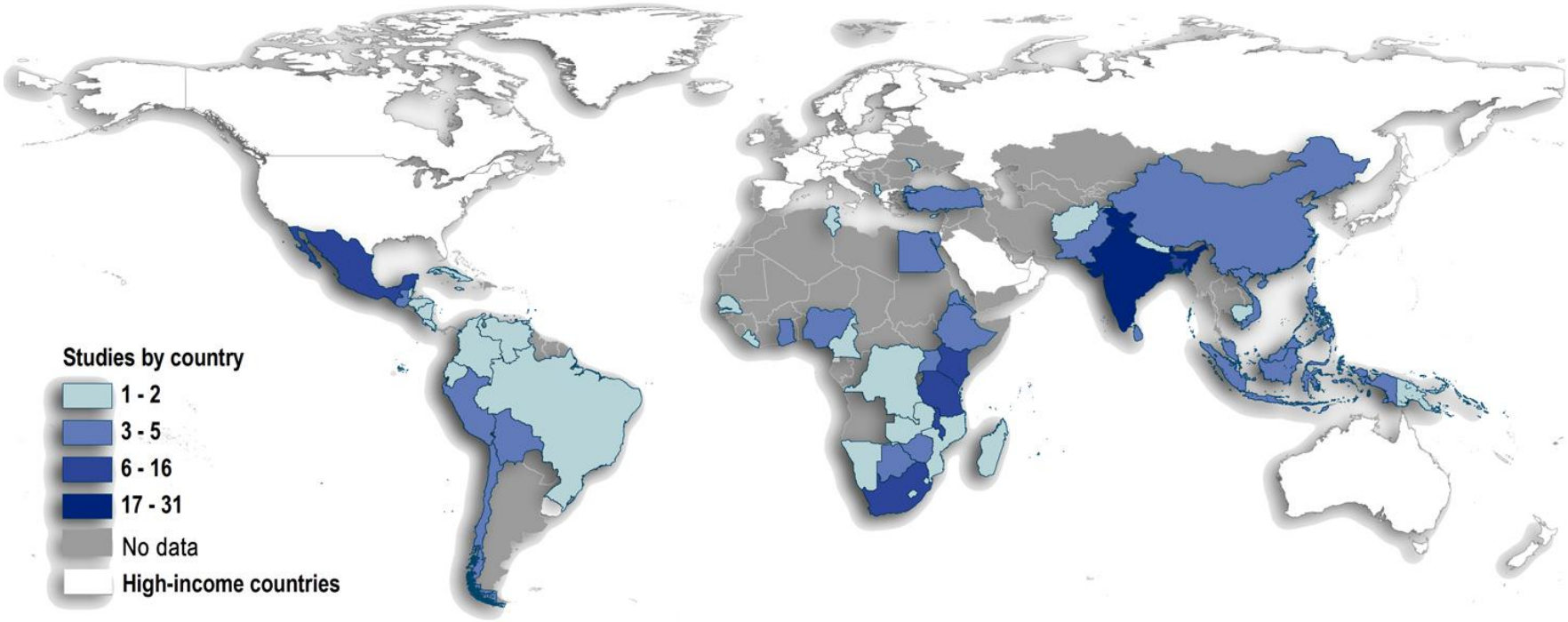
1. language and literacy learning from early childhood to Grade 8 (approximately 3-13 years)
2. mathematical reasoning and numeracy learning up to Grade 2 (approximately 3-8 years).

The rationale is that by Grade 8, literacy skills should be fully developed for both reading and writing. Since the scope of the review has to be restricted, numeracy is reviewed only up to Grade 2, by which stage, foundation skills fundamental to progress in mathematics and mathematical reasoning should be in place.

Figure 2.1 illustrates the source of data from the various developing countries that were included in our review.

It is important to note that the rate of procurement of the papers and documents was only average. Highest procurements were for the strands related to contextual factors and literacy development (~90 per cent). The lowest procurements were for published studies evaluating interventions using a quasi-experimental design and studies on the role of oral language in literacy and mathematical reasoning (~60 to 70 per cent). Non-procurements were mainly for doctoral theses (despite strenuous attempts to contact the universities concerned) and papers published in technical journals from the developing countries. Appendix 2 gives the number of papers seen at each stage of the selection process.

Figure 2.1: Representation of included studies by country



3. Language as a foundation

The goal of reading is understanding; this is the product of decoding skills (the ability to translate between print and sound) and linguistic comprehension. At a more basic level, decoding depends upon knowledge of the symbols of the language (e.g. letters in the European languages; akshara in languages of South and Southeast Asia) and phonological awareness (the ability to reflect on the sound structure of spoken words). It follows from this so called Simple View (Gough and Tunmer, 1986) that if children have poor language, they will not be able to become fully literate even though they might decode well. Similarly, language skills are important for numeracy. The fundamental skill of counting draws upon language skills, and the ability to solve verbally posed problems requires good language comprehension.

Thus, the teaching of literacy takes as its starting point a child's language proficiency and the need to ensure a solid **language foundation** (National Early Literacy Panel, 2008). Children also thrive better in the reading stakes if they come to school with emergent literacy skills, and in particular, if concepts of print are well established. In addition, it has become widely accepted that a systematic phonics approach provides the most effective method for teaching decoding skills (e.g. National Reading Panel, 2000), though this recommendation is largely restricted to the teaching of Latin-based scripts such as English and Spanish. Relatively less is known about the most effective interventions for numeracy; however, the most promising effects of mathematics instruction are obtained with direct, skill-based practice using appropriate manipulative materials. Moreover, in addition to the critical role played by conceptual knowledge of quantity and numbers, and their relations, a growing body of research suggests that the ability to identify and label quantities using number words is important and that working memory skills, themselves language-dependent, play a role in supporting operations such as addition and multiplication. In this review, the term **oral language** includes expressive language (talking) and receptive language (comprehension), but we lay a greater emphasis on comprehension.

4. Bilingual and multilingual contexts

As we have seen, oral language is the foundation of literacy and numeracy; more generally, it is the vehicle of learning and instruction. The impact of low levels of language on literacy development (Hoff, 2013; Roy and Chiat, 2013) and educational attainment is therefore a matter of concern even in resource-rich contexts (All Party Parliamentary Group on Speech and Language Difficulties, 2013). The situation for many children entering school in developing countries is typically more complex, with children exposed to one or more indigenous languages as well as a national and/or post-colonial language, and potentially arriving at school with limited or no experience of the language of instruction.

A synthesis of 14 ethnographic studies[5] shows that planned school activities to build bridges between the child's **home and school language** are conspicuously absent. This was seen for Arabic learning in Eritrea, English in Ghana, Spanish in Mexico, Hindi in India and Urdu/Arabic in Pakistan. Instead, the home language surfaced during play and unsupervised time, and in a community's attempt to connect the home to the school. A mother's perception that children have to 'teach themselves' (Mount-Cors, 2011 →, p. 194), captures the learning situation for many second language learners in her coastal town in Kenya, but may also speak for children in several other settings examined in this review.

Another side of the story of language learning is home-school relations. Families can take the position that home language is most relevant for home matters and non-essential for either literacy learning or social mobility. This position is captured by community members in rural Peru saying that Quechua literacy (home language literacy) is 'of little use' (de la Piedra, 2010 ↑, p. 103). Teacher attitudes may also work in tandem to undervalue home language, with robust evidence that the child's linguistic heritage is ignored in school. These factors, along with the absence of children's books in the home language, drive a wedge between the language of the home and school.[6]

The choice of language for literacy and instruction has been a major issue of debate and contention and is beyond the scope of this review. Nevertheless, there is reasonable consensus that, where possible, children's initial instruction should be in their mother tongue.[7] However, in many contexts, identifying a language that qualifies for mother tongue instruction is no simple matter. Walter (2011, p. 23) points out that 'some sociolinguistic settings are much better candidates for mother tongue education than others', and argues that the language spoken by the majority in the children's environment is optimal for instruction. Even in contexts where there is a single shared mother tongue, this does not guarantee that children's oral language skills in their mother tongue are adequate for literacy instruction. A macro-level analysis of factors influencing Grade 6 reading achievement in 14 Southern African countries (SACMEQ [8] data, Hungi and Thuku, 2010 ↑) found that speaking the language of instruction at home was a significant predictor of reading success. However, there was one exception to this finding (home language education was not a predictor of reading success in Lesotho), and in the 13

[5] Akrofi, 2003 →; Asfaha and Kroon, 2011 →; Azuara, 2009 ↑; Azuara and Reyes, 2011↑; Cianca, 2012 ↑; Cleghorn, et al., 1998 ↑; de la Piedra, 2006 ↑; 2010 ↑; Dyer, 2008 ↑; Farah, 1991 →; Guha, 2006 →; Mount-Cors, 2011 →; Rumiati and Wright, 2010 ↑; Saigal, 2012↑

[6] Converging evidence comes from studies on home literacy environment where children's reading achievement are reported to be favourably related to use of the language of instruction at home (Hungi, 2008 ↑; Kalia, 2009 ↑; Smith and Barrett, 2011↑; Willenberg, 2004 →; Yu and Thomas, 2008 ↑) and parents meeting with teachers (Aturupane et al., 2013 ↑; Willms and Somers, 2001↑).

[7] See Walter, 2011 and Gouleta, 2006, for a review of bilingual education practices in developing countries of Asia, Africa and Latin America; and Alidou et al., 2006, for a stocktaking on mother tongue and bilingual education in sub-Saharan Africa. Also see August and Shanahan (2006).

[8] The Southern and Eastern Africa Consortium for Monitoring Educational Quality

countries where positive effects were found, these varied in magnitude. Likewise, an analysis of attainments of Grade 4 and 5 pupils in the 11 official languages of South Africa found varied effects (PIRLS [9] data, Howie et al. 2008 →). Thus, while familiarity with the language of instruction is important, its influence clearly depends on other factors. This is in line with findings for monolingual children in economically developed countries who start school with inadequate oral language skills in their mother tongue (Hoff, 2013; Roy and Chiat, 2013; All Party Parliamentary Group on Speech and Language Difficulties, 2013).

Turning to research more specifically focused on the role of oral language skills in learning to read, the literature from developing countries mirrors that from economically developed countries in finding that phonological awareness (in the language of instruction) is a predictor of decoding ability. Far fewer studies (in either literature) focus on vocabulary, oral language skills or oral comprehension. Those that do, find higher proficiency on these oral language skills to be associated with improved literacy development.[10]

Clear implications therefore emerge from research on oral language and literacy:

1. Whatever the language of literacy, solid foundations in oral language, particularly vocabulary knowledge and sentence comprehension, are essential prerequisites for literacy development in that language. It should be emphasised that there are benefits irrespective of whether these foundations are in the 'standard' language or non-standard varieties; the crucial point is that children should have sufficient mastery of vocabulary and syntax to enable them to make inferences from text.
2. Where children do not have the oral language skills needed for literacy, an intervention targeting these skills is vital. This is as true for children living in socially disadvantaged communities in the economically developed countries as for those growing up in the linguistically complex contexts of developing countries. Furthermore, this intervention needs to be early if it is to provide an effective scaffold for learning (e.g. National Reading Panel, 2000).

[9] Progress in International Reading Literacy Study

[10] e.g. for reading comprehension: Asfaha et al., 2009a ↑; Kim and Pallante, 2012 ↑; Nag and Snowling, 2011 ↑; for decoding: Babayigit and Stainthorp, 2010 ↑; Winskel and Widjaja, 2007 ↑; for emergent literacy: Kalia 2007 →; Vagh, 2009 ↑.

5. School instruction in developing countries

There is a remarkable similarity in literacy and numeracy instruction across the 14 ethnographic studies conducted in developing countries (see Appendices 3 and 4 for a 'map' of these studies). The focus is on getting the 'correct' answer. In literacy for example, 'basic decoding skills and the formal features of texts, sentences, and words were valued over understanding, construction of meaning, and student creativity' (de la Piedra, 2006 ↑, p. 388-389). Lessons for creative writing or activities to support the child as author were rare. Practices related to literacy and numeracy instructions were also notably similar:

1. **Chorus, copywriting and drill** are the most visible aspects of class instruction. They are used to practise a range of literacy skills (see Table 5.1). However, there is also variety in these practices, suggesting a responsive approach to teaching. Moreover, since these practices in all their variations do not require any additional materials, they are economical and do not place further strain on limited resources. Two additional points are of interest: first, these practices are also seen in home tutoring, suggesting that parents copy what they see in school, with mixed results.[11] Second, for some adults, copywriting and repetition are personal ways of immersing themselves in written language (e.g. with religious texts, songs, de la Piedra, 2006 ↑; 2010 ↑), suggesting intergenerational roots for these practices in some communities.
2. All studies report the spontaneous and/or scripted use of **child-to-child peer tutoring**. The method could be an imperfect solution to class management. It may also be that teachers are teaching the older and/or brighter children in class, leaving the rest to catch up. One programme with 'cross-age buddies' reported improvement in spoken language skills as well as motivation of both children (Cianca, 2012 ↑). Many of these settings (e.g. rural agrarian communities) are collectivist in orientation where the child learns from the group, and the role of tutor is a natural one for older children and peers to take (e.g. Ngara, 2007).[12]

Table 5.1 captures these prevalent classroom practices, the implications of which we discuss next.

[11] Positive effects are reported on learning letters of the alphabet (Kalia, 2009 ↑; Strasser and Lissi, 2009 ↑) and general reading achievement in the early grades (Smith and Barrett, 2011 ↑; Tayyaba, 2012 →) but also nil to negative effects are reported on literacy development and mathematical achievement in studies spanning pre- to middle-school years (Smith and Barrett, 2011↑; Vagh, 2009 ↑; Willms and Somers, 2001 ↑).

[12] Siblings, cousins and peer group in the neighbourhood also play a prominent role in home tutoring (Azuara, 2009 ↑; Azuara and Reyes, 2011 ↑; Farah, 1991 →; Kvalsvig et al., 1991 ↑; Vagh, 2009 ↑; Willenberg, 2004 →).

Table 5.1: Prevalent literacy instruction practices in classrooms in Ethiopia, Eritrea, Ghana, India, Kenya, Mexico, Pakistan and Peru

Chorus	Copywriting	Drill	Peer Support
• Letter names • Word lists • Sentences from texts • Answers to questions in lessons	• Letters • Lists of words • Full sentences • Paragraphs	• Spellings • Answers to questions	• To finish tasks • To clarify lessons • To 'teach'
• Number names • Number facts • Pithy phrases for steps to problem solving	• Numbers • Mathematical signs • Practice sums • Multiplication tables	• Counting • Number facts • Practice sums • Mental maths	

5.1 Decontextualised teaching

The gap between the lesson and the context can occur at two levels. First, within the classroom situation, instruction may be without context. To illustrate, copying 'answers' is common. This emphasis does not make contact with pupils' own spoken language, narrative or world knowledge, though both could have been a way to enhance vocabulary and text comprehension. Second, teachers often ignore children's home culture, literacy artefacts in the community, and family practices with print, especially when parents have low levels of literacy. Only a few examples were available of connections between school activities, practical knowledge and daily life (e.g. writing a missive in Azuara, 2009 ↑). This disconnect is captured in the words of a school-going girl's parent in rural Pakistan: 'teachers do not transfer skills to everyday requirements' (Farah, 1991 →, p. 79). Rather, since teaching is not typically explicit in making links between discrete concepts, children must map school-based lessons to 'out-of-syllabus' real-world information by themselves. Much is therefore left to unplanned experiences and spontaneous insight, and this in turn means that a lot depends on the child's own profile of strengths, such as level of phonological awareness, knowledge of letters and symbols of the writing system, vocabulary knowledge and ability for inference making.

5.2 The stated and transacted curriculum

A gap often exists between daily class routines and the 'formal' curriculum found in the country's policy documents (e.g. Eritrea: Asfaha and Kroon, 2011 →; Mexico: Azuara, 2009 ↑). In some cases where materials that could promote literacy had been supplied, the teachers had not yet integrated these into teaching practice (e.g. reluctance to lend storybooks to children for fear of damage, Akrofi, 2003 →). Nor did classroom practices always keep pace with methodologies of newly prescribed government textbooks (e.g. in India, Dyer, 2008 ↑); instead they reflected either traditional, religious-cultural practices or rote memory based practices.

Taken together, the studies give evidence that constraints on literacy (and numeracy) instruction in schools are at the linguistic, pedagogical, structural, social and cultural

levels.[13] There are many reasons for the persistence of methods of rote and surface learning, but the evidence clearly indicates that these constrain learning if individual differences in the skills children bring to school are not taken into consideration, and the methods do not make more explicit what is required for competency.

[13] However, it must be emphasised that practices at the cultural level also offer opportunities (e.g. enabling peer-to-peer learning)

6. Individual differences in literacy development

6.1 Decoding skills: effects of script and of child characteristics

Writing systems differ in the ways in which the symbols relate to the sounds – known as *transparency*. Among the European alphabetic systems for example, languages differ in how consistently sounds (phonemes) map onto letters and letter groups (graphemes). In languages with transparent orthographies, such as Spanish, Finnish and German, letters are in a very consistent relation with sounds. In contrast, in less-transparent systems (e.g. French, English), letters and sounds are in one-to-many relations. English is the prime example of an *opaque* language, with single letters such as *c* and *s* mapping on to the same or different sounds (*ceiling*, *sealing*, *calling*, *seas*, *sugar*). These differences primarily affect the *rate* of reading and spelling acquisition, which is faster in orthographies that are more transparent. The learning rate is also slower when writing systems are more visually complex, as in Arabic and Hebrew or Urdu and Hindi (e.g. Abdelhadi et al., 2011; Rao et al., 2011). Nevertheless, comparisons across alphabetic languages in high-income countries show that there are just three predictors of individual differences in decoding (reading, spelling) ability: letter knowledge, phonological awareness and rapid naming (the latter being a measure of naming speed, most important for fluency) (Caravolas et al., 2013); this is also true for second language learners (Geva and Siegel, 2000; Geva et al., 2000). These skills, along with vocabulary knowledge, influence literacy development.

Languages also differ in the size of speech units that link to written symbols. In alphabetic orthographies, letters map on to phonemes (for example, *b, k, s, f, l, m* each maps on to a single consonant in English), and a relatively small set of letters make up the alphabet (usually 20-30) from which all written words are composed. In contrast, some languages like Chinese or Japanese kanji map sounds on to characters at the level of the morpheme or meaning unit. In South and Southeast Asia, and in Ethiopia and Eritrea, the writing system maps sounds to syllables, but each symbol also has alphabet-like features to represent the phoneme (hence the name 'alphasyllabaries'). In alphasyllabaries, the symbol set is large (more than 400 symbols in Bengali and Hindi, for example). Closely linked with the 'grain' size of the sound-symbol association is therefore the *extensiveness* of the set of symbols. There is a small body of evidence showing that while the extensiveness of the symbol set places considerable demands on the young learner well into middle school, the syllable-level representations of symbols is an advantage for understanding the principle of mapping symbol to sound (Asfaha et al., 2009b ↑; Nag, 2007 ↑; Nag and Snowling, 2012 ↑).

A synthesis of evidence from 18 languages[14] shows that children's phonological awareness, knowledge of the symbols of the writing system and/or knowledge of vocabulary are good predictors of individual differences in learning to read and spell. Vocabulary knowledge is important for distinguishing homophones (e.g. *witch-which* and *seize-sees*), and reading exception words (e.g. *people* and *would*), and recognition of word structure (prefixes, roots and suffixes) is important for recognising components of words (e.g. *inverse-inversion* and *king-kingdom*). In scripts with large numbers of symbols, vocabulary knowledge combined with the more familiar symbols in the word can help children to

[14] Alcock and Ngorosho, 2007 ↑, Kenya, Kiswahili; Alcock et al., 2010 →, Tanzania, Kiswahili; **Asfaha et al., 2009b ↑**, Eritrea, Arabic, Kunama, Saho, Tigre and Tigrinya (L1) – English (L2); Babayigit and Stainthorp, 2010 ↑ Northern Cyprus, Turkish; **de Sousa et al., 2010 ↑**, South Africa, Zulu-English; Elbeheri and Everatt, 2007 →, Egypt, Arabic; Kim and Pallante, 2012 ↑, Chile, Spanish; Lee and Wheldall, 2011 →, Malaysia, Malay; **Mishra and Stainthorp, 2007 ↑**, India, Odia-English; Mohamed et al., 2011 ↑, Egypt, Arabic; Nag, 2007 ↑, India, Kannada; Nag et al., 2010 ↑, India, Kannada; Oktay and Aktan, 2002 →, Turkey, Turkish; **Sen and Blatchford, 2001 ↑**, India, Bengali-English; Strasser and Lissi, 2009 ↑, Chile, Spanish; **Tahan et al., 2011 →**, Egypt, Arabic-English; **Veii and Everatt, 2005 →**, Namibia, Herero – English; Winskel and Widjaja, 2007 ↑, Indonesia, Indonesian (studies with L2 literacy are in bold).

guess it. In addition, the child's visual and motor skills are predictors of early reading development in the visually complex writing systems (e.g. the akshara and Arabic symbols), though the strength of evidence is very small in this area.

What is clear is that despite the universal nature of many predictors, language-specific characteristics determine the exact measure that will be sensitive to individual differences. Thus, some predictors are stronger for some languages and writing systems than others (e.g. syllable processing for Kannada, phoneme processing for Bahasa Indonesia, and morphological knowledge for Turkish). One implication of these findings is that good-quality assessments require psycholinguistic measures of skills that are *relevant* for the language of literacy instruction in developing countries; a simple translation (adaptation) of tasks can miss important information. Box 6.1 gives the list of predictors evidenced in the alphasyllabic and alphabetic languages among first and second language learners.[15,16]

Box 6.1: Predictors of individual differences in literacy that are useful to assess in the early grades

Phonological Awareness

Syllable awareness for writing systems that map to syllable level units (e.g. the Indian akshara languages)

Phoneme awareness for writing systems that map to phoneme level units (e.g. the alphabetic scripts of English, Spanish and Arabic, and at later stages of learning for the alphasyllabic scripts like the Indian akshara systems)*

Symbol Knowledge

Akshara and symbol blocks in the alphasyllabaries*

Letters and symbols of the alphabet in the alphabetic languages*

Vocabulary Knowledge

Exception words that do not follow a transparent sound-symbol mapping

Words with multiple units (multi-morphemic words)

Note: Tasks marked with an asterisk (*) are currently included in large-scale assessment systems like Early Grades Reading Assessment (EGRA), Annual Status of Education Report (ASER) and UWEZO. The evidence for the other tasks comes from high-quality small-scale studies.

[15] Alcock et al. 2010 →; **Asfaha et al., 2009a ↑**; Babayigit and Stainthorp, 2010 ↑; **de Sousa et al., 2010 ↑**; Elbeheri and Everatt, 2007 → ; Kalia, 2009 →; Kim and Pallante, 2012 ↑; Lee and Wheldall, 2011 →; **Mishra and Stainthorp, 2007 ↑**; **Nag-Arulmani et al., 2003 ↑**; Oktay and Aktan, 2002 →; **Veii and Everatt, 2005 →**; Winskel and Widjaja, 2007 ↑ (studies with L2 literacy are in bold)

[16] An important predictor in many languages and writing systems is a speed of processing measure called Rapid Automatized Naming (RAN). We have not focused on this because it is as yet unclear what exactly this task taps, and whether the task is meant to be of clinical value or to be taken into the classroom for purposes of screening.

6.2 Reading comprehension

Fluent recognition of individual words in sentences is an important step to proficient reading comprehension. However, while necessary, this is not sufficient for text comprehension. Rather, wider knowledge about the use of words in multiple contexts, their grammatical forms and the nuances of meaning that they can communicate (e.g. 'teacher' versus 'facilitator' versus 'instructor') lends depth of meaning to reading comprehension. It appears that the quality of binding together of these dimensions of word knowledge may also matter (Perfetti, 2007). Finally, recognising and understanding relations between words when these are combined into sentences is essential for sentence and text comprehension. The critical point in this theoretical framework is the central role of *depth* of spoken language knowledge for reading with understanding, especially for second-language learners, as is also the case in high-income countries (Melby-Lervåg and Lervåg, 2011).

Although comprehension of meaning is the goal of reading, comprehension skills are less amenable to rigorous assessment than decoding and fluency skills, and many measures of reading comprehension confound accuracy with comprehension (Keenan et al., 2008). However, studies in the current review confirm that reading comprehension may be poor even when word recognition is high, and poor language comprehension is a block on reading comprehension.[17]

Together, these findings underline the critical importance of both phonological and broader language skills as determinants of reading. It is important to note, however, that the National Early Literacy Panel (2008) found that oral language was a better predictor of later literacy achievement when assessed using measures that included grammar, the ability to define words and listening comprehension, rather than just simple vocabulary knowledge (e.g. naming pictures).

6.3 Transfer of skills across languages

Transfer of skills across languages refers to the generalisation of learning from one language to another. Research from high-income countries indicates that, for second-language learners, high levels of phonological awareness and decoding proficiency in the first language can be beneficial for learning the same skills in a second language (i.e., they demonstrate positive transfer effects). However, there is no transfer of reading comprehension skills – these depend critically upon being proficient in the specific language of the text.[18] A very small body of cross-linguistic research on bilingual and multilingual contexts in developing countries also points to transfer of phonological skills across languages (e.g. transfer from English to Zulu: de Sousa et al., 2010 ↑; to Odia: Mishra and Stainthorp, 2007 ↑; and to Herero: Veii and Everatt, 2005 →). It is possible that the transfer of phonological skills across languages depends upon the phonological skills of individual children (i.e. children with stronger phonological awareness skills in one language are more able to transfer their skills to a second language). However, none of the papers included in the review investigated this issue.

[17] Findings are from studies with L1 literacy (Kim and Pallante, 2012 ↑; Nag and Snowling, 2011 ↑; Spratt et al., 1991 →) and L2 literacy (Asfaha et al., 2009a ↑; Nag-Arulmani et al., 2003 ↑; Pretorius and Currin, 2010 →; Sen and Blatchford, 2001 ↑; Williams, 1993 →, 1996 →, 1998 →).

[18] Findings are from studies with L1 literacy (Kim and Pallante, 2012 ↑; Nag and Snowling, 2011 ↑; Spratt et al., 1991 →) and L2 literacy (Asfaha et al., 2009a ↑; Nag-Arulmani et al., 2003 ↑; Pretorius and Currin, 2010 →; Sen and Blatchford, 2001 ↑; Williams, 1993 →, 1996 →, 1998 →).

7. Becoming numerate

From early infancy, children have what has been termed a 'number sense': an infant watches two objects being hidden behind a screen; when the screen is removed, if there is now only one object, the baby's behaviour will indicate surprise. Learning to be numerate requires the child to build on this sense of 'numerosity' to learn the number system of their language, how numbers can be combined, subtracted, multiplied and divided, and how problems involving numbers, money and other basic quantities are solved. It follows that education systems must include these concepts and skills in the pre- and primary school curriculum. What is also clear is that cognitive abilities in turn build on non-verbal reasoning and oral language, particularly counting ability. Thus, the aims of teaching mathematics in these early years should not be reduced to teaching only arithmetic but should be inclusive of activities that foster a clear and logical approach to problem solving.

Individual differences in numeracy already surface in foundation learning, e.g. when comparing the magnitude of pairs of numbers (e.g. 2 versus 4) and in enumerating or estimating the number of objects in a small set. These differences appear to be associated with variations in general cognitive ability, working memory and language skills, and understanding the semantic content of word problems.[19] The role of language in the development of numerical cognition becomes particularly critical when instruction and mathematical problems are presented in a language of limited fluency such as the child's second (or third) language and can be expected to impede performance on word problems more than basic computations.[20] There is also evidence of socio-economic, ethnic and gender differences in mathematical reasoning (Royer and Walles, 2007).

Also influential in shaping numerical cognition is culture and context.[21] The role of context is seen both in the development of mental concepts about numbers and approaches to problem solving (e.g. knowledge from trading practices among out-of-school children). Even among those in school, there is a gap in what children bring from everyday experience and how numbers are introduced through lessons. Thus, there is a distance between 'embedded' tasks of numerical reasoning and 'formal' mathematics. In this light, numeracy learning in the early grades is about reconciling hands-on knowledge of numbers from everyday experience with the skills and knowledge taught through the algorithms of school mathematics.

Our review reveals enormous variation in mathematics instruction in the early grades often relating to both the availability and structured use of teaching-learning resources.[22] Although the resources required for numeracy instruction are readily available in communities, as with literacy, teachers struggle with more child-centred teaching methods, numeracy instruction is delivered through choral lessons and written practice, and there is little use of manipulatives (materials and models to help in concept learning) and a preference for teaching without elaboration (focus only on factual details). In classrooms that are driven by such formulaic ways of teaching mathematics (see Table 5.1), tension can be high between intuitive strategies for mental mathematics and formal instruction, and between intuitive approaches to mathematical reasoning and scripted procedures taught for solving word problems in school.

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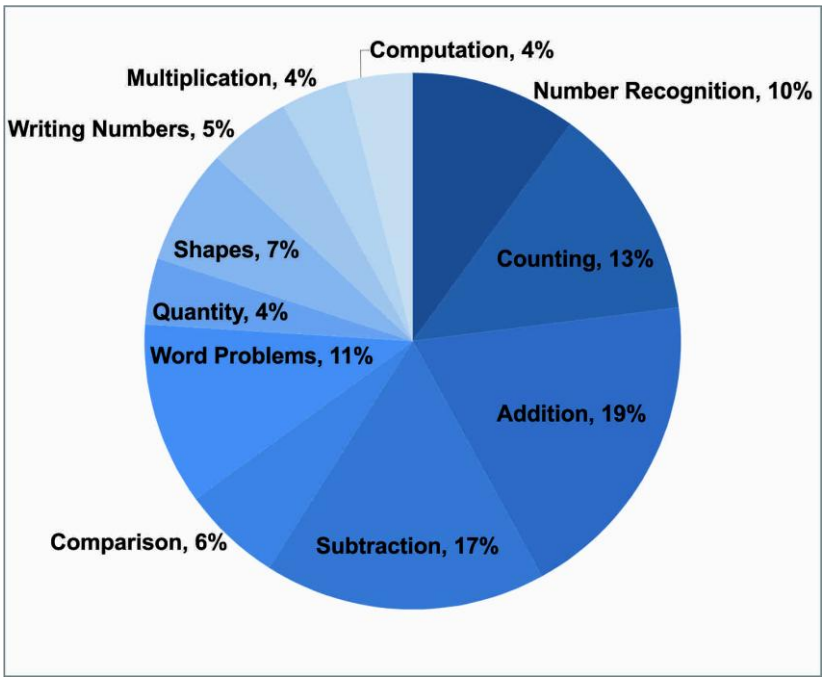
[19] e.g. Geary et al. (2009); Fuchs et al. (2010); LeFevre et al. (2010); Piaget (1952)
[20] For later grades: Tolar et al. (2012)
[21] Saxe (1997); Schliemann and Carraher (2002); Schliemann and Nunes (1990)
[22] Aboud, 2006 ↑; Aboud and Hossain, 2011 ↑; Bautista and Mulligan, 2010 ↑; Bautista et al., 2009 →; Bernardo, 2002 ↑; Brouwers et al., 2006 ↑; Cleghorn et al., 1998 ↑; De Lisle et al., 2010 ↑; Farah, 1991 →; Guha, 2006 →; Guild, 2000, →; Mooko, 2004 ↑; Neo and Heng, 2012 ↑; Ng, 2011 ↑; Opel et al., 2012 ↑; Rao et al., 2012, ↑; Rumiati and Wright, 2010 ↑; Stevenson et al., 1990 ↑

There is strong evidence that in bi- and multi-lingual contexts, teachers spontaneously draw on the children's home language for explaining mathematics.[23] This code switching was seen throughout the lesson in Malaysian rural and urban classrooms (Neo and Heng, 2012 ↑), which was unlike lessons in Zimbabwean classrooms, where the home language appeared only towards the end of the lesson, when the formal lesson plan had been completed (Cleghorn et al., 1998 ↑). This use of code switching, code mixing and hybrid structures appears to be an important part of a teacher's toolkit for ensuring that children comprehend abstract concepts and approaches to problem solving and mathematical reasoning (e.g. Bose and Choudhury, 2010 for later grades).

The language of mathematics requires attention to both word meanings (semantics) and the relationships between them (syntax). Sometimes this can be a challenge in *both* the home language and in the school language, as shown in a series of studies from the Philippines (Bautista and Mulligan, 2010 ↑; Bautista et al., 2009 →; Bernardo, 2002 ↑). Thus, 'probing questions showed that children interpreted 'Then Alma gave her some more pencils. Now Jolina has 12 pencils' as 'Alma gave 12 pencils' (Bautista and Mulligan, 2010 ↑, p. 74). A complicating factor is that some languages may lack the terms for certain mathematical concepts (e.g. Setswana: Mooko, 2004 ↑), while some languages (e.g. Bengali: Opel et al., 2012 ↑) have number names that refer to quantities in a regular way, which in turn makes it easier to learn to count and understand relations between numbers.

A synthesis of the papers documenting mathematics skills assessed in early childhood settings and in the early grades shows that the focus is on number knowledge (see Figure 7.1). The exceptionally low attention to mathematical reasoning skills reflects a broader trend seen in the field of mathematics assessment on a large scale, such as in the Early Grades Mathematics Assessment (EGMA) and Annual Status of Education Report (ASER) surveys.

Figure 7.1: Assessment of mathematical reasoning and numeracy in developing countries



[23] There are, however, many situations where teachers do not know the home language(s) of the children in their class

Some pointers for planning assessment of mathematical reasoning and numeracy in the early grades come from a small but high-quality set of studies:

1. **Allow code switching**: Class-based assessments often privilege the school language to the extent of neither allowing the child to express solutions in the home language nor supporting reading comprehension for written problems. When children are supported for reading comprehension, and allowed an explanation of the question as well as giving the solution in the home language, performance improves, as shown in Filipino-English classrooms in the Philippines (Bautista and Mulligan, 2010↑).
2. **Introduce 'real-life' mathematics**: School-based assessments of mathematics essentially use formal (decontextualised) tests, rather than embedded tests that use local context and day-to-day experiences to evaluate children's intuitive reasoning, number sense and verbal number knowledge. In studies where embedded tests have been used, children show evidence of skill even if they have never enrolled in a formal school programme (Brouwers et al., 2006 ↑).
3. **Be alert to out-of-school approaches**: Accepted approaches to solving mathematical problems may ignore the traditional systems of computation in use within the community (Panda, 2004, 2006; Wassmann and Dasen, 1994) and children exposed to both school and home/community approaches may be confused about how to integrate the several systems of computation (Bautista et al., 2009 →; Rumiati and Wright, 2010 ↑). The process of assessment needs to be sensitive to the confusion and not prematurely assume poor levels of skill.

In summary, the review provides a fairly consistent picture of the teaching of numeracy in the countries that have been studied. The emphasis is on relaying number facts using methods that rely substantially on recitation and rote-learning methods. There is comparative neglect of the teaching of number concepts and arithmetic strategies and very little attention is paid to embedding problem solving in familiar contexts. A major issue is the language of the classroom. This can be as abstract and removed from everyday experience as it can be in economically developed countries.

A final point is the evidence from developing countries of a stark attainment gap in mathematics across socio-economic level, gender and geography. [24,25,26] As with literacy attainments, key mechanisms behind the attainment gap are often intangible but strongly related to resource availability and use, including access to learning materials, a match between school tasks and everyday experiences, quality of parent and teacher attention, and school attendance that is uninterrupted by household demands or economic and socio-cultural shock.

[24] Higher SES advantage: Hungi (2008 ↑, Vietnam); Garrouste (2011 ↑, Namibia); Sharma (1997 ↑ India); McEwan and Jimenez (2002 →, Bolivia); Tayyaba (2012 →, Pakistan); and cross-national studies: Chiu and Xihua (2008 ↑); Chudgar and Luschei (2009 ↑) Yu and Thomas (2008 ↑)

[25] Boy advantage: Garrouste (2011 ↑, Namibia); Heady (2003 →; Ghana); McEwan and Jimenez (2002 →, Bolivia); Mpofu (1997 →, Zimbabwe); Willms and Somers (2001 ↑, Brazil, Chile, Colombia, Cuba, Honduras, Mexico and Venezuela); Yu and Thomas (2008 ↑, Tanzania); but note report of girl advantage in Sri Lanka: Aturupane et al., 2013 ↑

[26] Urban advantage: Chowdhury et al. (1994 ↑ Bangladesh); Garrouste (2011 ↑, Namibia); Mohsin et al. (1996 →, Bangladesh); Stevenson et al. (1990 ↑, Peru); Tayyaba (2012 → Pakistan); and cross-national studies, e.g. Hungi and Thuku (2010 ↑)

8. What works for language, literacy and numeracy?

For language, literacy and numeracy, we conducted a review of interventions promoting learning in preschool and school settings. After excluding studies of low quality, we include the findings of eight trials using the 'gold standard' design of the randomised controlled trial (RCT) and eight studies using less robust experimental methods with quasi-experimental designs (QEDs). We have supplemented this evidence with findings from interventions targeting the home language and literacy environment.

The higher-quality studies reported interventions in a variety of developing countries[27] (for country profiles see Appendix 5). A trial or experimental study gives evidence about the magnitude of effect size of an intervention. Ensuring programme fidelity when introducing an intervention with good evidence *on a large scale* is, however, influenced by several factors unique to each developing country, and thus cultural sensitivity is as critical as methodological quality. Only a few interventions were judged culturally appropriate for fostering numeracy and literacy development in young children. Some interventions were not explicitly described such that they could be replicated.

For more details of included studies, see Appendices 6 and 7.

8.1 Improving literacy and numeracy

The systematic review of RCTs revealed evidence of two effective interventions: first, a programme in which schools were provided with age-appropriate reading materials to run a '31-day reading marathon' (Aberberese et al., 2011 →), and second, a whole-class dialogic reading intervention (Opel et al., 2009 ↑). These trials found positive effects on reading and on expressive vocabulary development respectively. For numeracy, there was evidence of efficacy for a programme which included 'hands-on' mathematics activities (Opel et al., 2012 ↑) and a computer-assisted learning programme (Banerjee et al., 2007 →). In addition, for programmes combining literacy and numeracy instruction, there was evidence of positive effects of four months' exposure to an educational multimedia intervention (Borzekowski and Henry, 2011 ↑) and a remedial intervention using young women from the local community as teachers (Banerjee et al., 2007 →). A brief summary of the programmes is given in Box 8.1.

Consistent with findings from resource-rich countries, our expert review of the QEDs reported reading interventions with a phonological/phonic basis to be effective. However, only one intervention in the synthesis trained children's phonological awareness (Nag-Arulmani et al., 2003 ↑). This study evaluated a three-week intervention for multilingual 7-9 year old children (Kannada-English). Children receiving the intervention showed greater improvement in reading when compared to a low-intensity language intervention focusing on vocabulary building.

[27] Bangladesh, Costa Rica, India, Indonesia, Kenya, Morocco, Philippines, Sri Lanka, Tanzania, Turkey, and Uganda.

Box 8.1: Summary of the moderate-high and high quality RCT programmes

***Balsakhi* intervention (India):** The 'weakest' 15-20 children taken out of regular classrooms to work with Balsakhi (volunteer teachers) on basic skills (literacy and numeracy) for two hours per day for one year. A standardised curriculum was developed by NGO Pratham. Instruction focused on the core competencies that children should have learned in 1st and 2nd grades - primarily basic numeracy and literacy skills. The Balsakhi received two weeks training at the beginning of the year and ongoing support. The intervention was low cost: each teacher was paid 10-15 dollars per month; overhead and capital costs were also low (Banerjee et al., 2007 →).

***Jalan Sesama* (Sesame Street) intervention (Indonesia)**: Different levels of intensity of a 14-week multi-media intervention (high or low intensity) were implemented. The high intensity intervention involved up to 52 episodes of Jalan Sesama, with 3-4 DVD episodes per week for 14 weeks. The low-intensity intervention involved one DVD episode per week for 14 weeks. Families were paid $10 for participation (Borzekowski and Henry, 2011 ↑).

***Sa Aklat Siskat* intervention (Philippines):** Provision of age-appropriate reading materials and a 31-day 'reading marathon'. The reading marathon encouraged 'students to read as many books as possible through daily, in-school reading activities such as story-telling sessions, reading games, and posters displaying each class's progress'. The Sa Aklat Siskat developer donated 60 Filipino storybooks to every fourth grade classroom at participating schools (Aberberese et al., 2011 →).

Whole-class dialogic reading intervention (Bangladesh): Children were read 8 children's illustrated storybooks in Bangla over a four-week period. Dialogic reading is a form of shared storybook reading in which the adult reader engages the children in a verbal dialogue about the story as it is being read (Opel et al., 2009 ↑).

Computer-assisted learning intervention (India): A computer-assisted learning programme was adapted to each child's current level of achievement. Children in Grade 4 were offered two hours shared computer time per week (one hour during class time and one hour before or after school), during which they played games involving solving mathematics problems. A team of instructors from the local community were provided with five days computer training (Banerjee et al., 2007 →).

***Big Math for Little Kids* (adapted) intervention (Bangladesh)**: A comprehensive 9 month mathematics programme addressing skills such as numbers, measurement, shapes, patterns and space. The programme was used for 30 minutes daily for 6 days a week; activities on 58 skills were conducted during 97 school days. Teachers received 96 hours of training on 5 different days (Opel et al., 2012 ↑).

Family intervention (Costa Rica): This was a Spanish-language adaptation of Project EASE. Five sessions for parents were followed by an opportunity for parents and children to engage in structured, hands-on activities. Tutoring intervention: a maximum of 21 tutoring sessions of about 45 minutes each: reading, writing and work on letters/syllables. Classroom intervention: a focus on strengthening phonological awareness and letter/sound relationships in 18 sessions of approximately 45 minutes (Rolla San Francisco et al., 2006 →).

There was also moderate evidence of the efficacy of preschool enrichment programmes on foundation learning and emergent literacy skills. For example, a ten-week 'Summer Preschool Model' intervention for Kurdish-Turkish bilingual children from low-income homes (Bekman, et al., 2011 →) showed positive effects on school readiness. The programme emphasised cognitive skills, oral language, socio-emotional development and physical competencies; children showed substantial gains on measures of emergent literacy, syntactic knowledge (understanding grammar) and story comprehension when compared with control children.

There is, however, an issue regarding how to interpret the positive findings from these RCTs and QEDs. It is known that if an intervention provides extra attention or a new direction for teaching – and if this is not controlled for in the design of the RCT or QED - it can be expected to have an effect on pupil's performance – the so-called 'Hawthorne Effect'. This may be particularly marked in resource-poor settings where the majority of pupils might be receiving little quality input. Put another way, collectively, the interventions that have been evaluated provide limited evidence of how the impact of the intervention *mediates* (causes to change) children's attainments.

Furthermore, although the successful interventions highlight some possibly critical features, notably, a standard curriculum, the use of resources and/or incentives, and the adaptation of the programme to the level of the individual child, there has been no systematic investigation of the factors which are critical to their success. Nor has there been much consideration of moderators of (factors that affect) success, though some indications are provided by:

- two studies in which children's level of skill at the start of the intervention predicted gain; the weaker children gained most (Banerjee et al., 2007 →; Nag-Arulmani et al., 2003 ↑)
- one study in which gains in children's cognitive skills and school readiness scores were related to the quality of the preschool setting (Aboud, 2006 →)
- one study in which benefits depended upon mothers' education levels and knowledge of the school language (e.g. Bekman et al., 2011 →).

More generally, the QEDs highlighted the importance of teacher education for fostering foundation learning and the need for an emphasis on child-centred approaches. Two recent studies, sourced after the review was completed, indicate the possible issues related to teacher education. A six-country evaluation of teacher preparation for early grades teaching (Akyeampong et al., 2013 ↑) found that pre-service modules did not introduce the everyday skills to support reading for meaning and concept learning about numbers, but nevertheless 'induced misplaced confidence leading to standardized teacher-led approaches that failed to engage learners.' (p. 272). In contrast, a programme of teacher training in phonic instruction implemented in Uganda (Njuki and Nakitende, 2012 →) had positive effects both on teachers' own phoneme awareness and letter-sound knowledge (in English) and on pupil progress. In addition, teacher observation schedules can provide an important tool for monitoring children's progress.[28] While the use of such tools undoubtedly require teacher training and, ideally, supervision, they can play an important role in empowering teachers to attune the curriculum to individual children's needs.

Finally, interventions that co-opt parents to support implicit learning show promise. A summary on interventions to 'enrich' home literacy environments is given in Box 8.2.

[28] e.g. for phonics instruction in alphabetic languages: Snowling et al. (2011)

Box 8.2: Improving home literacy environment

Five intervention studies evaluated parenting outcomes following an intervention (Bangladesh: Aboud, 2007 →, Aboud and Akhter, 2011↑ ; Costa Rica: Rolla San Francisco et al., 2006 →; Morocco: Rochdi, 2009 ↑, Turkey: Kağitçibaşi, 1997 ↑, 22 year follow-up Kağitçibaşi et al., 2009 ↑; see Appendix 8 for the evidence 'map'). Some interventions were delivered as group sessions to mothers from low-income families, with mothers receiving individual sessions in the home in one study. The findings suggest that:

1. Early parenting interventions can have sustained and long-term benefits spanning well into young adulthood (Turkish Early Enrichment Project: Kağitçibaşi, 1997 ↑, Kağitçibaşi et al., 2009 ↑). The primary finding is that early enrichment, be it educational care, or via mother training for children in deprived environments, has benefits. Specifically, participants had higher educational attainment, joined the workforce at a later age and had higher occupational status. However, the degree of cognitive impairment at baseline predicted whether participants benefited from the programme. Participants with low initial cognitive skills did not benefit from participation in any form of enrichment, suggesting that these children need intensive intervention rather than enrichment. Moreover, the impact of enrichment on cognition and achievement was greater for male than female participants.
2. Programmes that are effective focus not only on instilling knowledge of child development but also on empowering mothers by providing and encouraging social support (Aboud and Akhter, 2011 ↑; Kağitçibaşi, 1997 ↑). They facilitate behaviour change by demonstrations, coaching mothers as they practise with their own child, and engaging in problem solving with mothers (Aboud and Akhter, 2011 ↑; Rochdi, 2009 ↑; Rolla San Francisco et al., 2006 →). In the absence of a practical skills component, unschooled mothers (or mothers reporting lower assets) were unable to put their increased knowledge on positive parenting and stimulation into practice (Aboud, 2007 →).

This small body of evidence suggests that early enrichment with parents as active participants (either home-based or centre-based) is of great value. Such interventions appear to take advantage of incidental learning and are particularly effective for children whose mothers have sufficient knowledge of school language and literacy to support the child in learning.

What didn't work? There are many potential reasons why interventions do not work and such 'null' results are uninterpretable. Here we provide examples of plausible reasons taken from the studies included in the review:

1. The Akshara Library Program: A primary school library programme had no effect on student scores in language tests, in other subjects or on attendance rates. This may have been because the programme was 'insufficiently intense' to impact on the outcomes of interest (Borkum et al., 2012 →).
2. A Spanish-language adaptation of Project EASE did not work, suggesting that providing high-quality materials to teachers without training had no impact (Rolla San Francisco et al., 2006 →).
3. An oral language intervention did not work because it was of 'low intensity and for too short a time' (Nag-Arulmani et al., 2003 ↑).

9. Evidence map and theory of change models

Remarkable progress has been made towards providing children in developing countries with access to education. Several challenges, however, remain for developing countries to meet the Millennium Development Goals (MDG) by 2015, and beyond. One challenge is to plan a theoretically grounded model for large-scale initiatives that is also informed by realities on the ground. We first present the strength of evidence for different intervention ideas and then propose theory of change (ToC) models developed iteratively based on extant knowledge and informed by the review that may be helpful for planning, implementation and evaluation of programmes.

A substantial body of evidence was found for literacy interventions in the early grades. However, very little systematic evidence was found for literacy interventions in later grades (either for reading comprehension or narrative writing) or for specific skill-based mathematics teaching in early grades, and therefore these areas cannot be commented on at this stage, though inferences can be made based on evidence from high-income contexts.

The starting point for the evidence map and theory of change models is the current teaching-learning situation (research reviewed in chapters 4 to 7): a) deeply entrenched classroom routines, b) low spoken language proficiency in the language of instruction and c) poor reading comprehension. These are elaborated further in the left-hand column of Tables 9.1 and 9.2, and taken up in the section on Enabling Conditions and Interventions in the models shown in Figures 9.1 and 9.2.

The right-hand columns in Tables 9.1 and 9.2 give information to appraise the strength of the evidence for different early grades literacy interventions. Two levels of evidence are given:

1. Findings from meta-analyses, and where this is missing, from high-quality individual RCTs in high-income countries (colour coded for strength of evidence in column 2)
2. Findings from our systematic review of high-quality RCTs and narrative review QEDs conducted in developing countries (see Appendix 9).

For research from developing countries, the appraisal of strength of evidence is based on four parameters operationalised as follows:

1. *Size of evidence*: This is based on number of studies: <3 very small, 4–6 small, 7–12 moderate, and >12 good.
2. *Research designs*: the various methods of investigation used for a specific intervention idea. Methods have been coded as Qual. (qualitative/ethnographic), RCT (randomised controlled trial), QED (quasi-experimental design), and Mixed (using both quantitative and qualitative data).
3. *Contexts*: This is based on number of countries covered and number of studies that are in low-income contexts. The numbers are as follows: <3 very small, 4–6 small, 7–12 moderate, and >12 good. In addition, an asterisk (*) communicates that two or more studies are about the same cohort or by the same implementing agency, suggestive of cohort effects and possibility of researcher-introduced biases.
4. *Consistency*: Based on what percentage of available papers show a similar direction of change in literacy related outcome variables: >90 per cent report improvements: high; 75 to 90 per cent report improvements: mixed; <75 per cent show improvement: low. Sometimes two studies may have examined a type of intervention but both are reporting results from a common cohort – in these cases 'cannot be inferred' is given.

The evidence is provided separately for intervention ideas for: a) promoting reading through a language and literacy programme in the early grades; b) ideas to effectively

respond to the current teaching-learning situation in many developing countries, especially for children in low-income communities; and c) ideas for teacher training to address the entrenched ways of teaching seen in many developing countries.

Table 9.1: Evidence map for interventions for literacy and foundation learning in the early grades: reading

Current teaching-learning situation in developing countries	**Intervention**[1]	**Strength of Evidence from developing countries**[2]			
		Size	**Research designs**	**Contexts**	**Consistency**
Didactic teaching is the norm with low focus on interactions around narratives and texts	Dialogic Reading	Moderate	RCT, QED, Mixed	Countries: Moderate* Low-income setting: Small*	High
	Story telling	Moderate	RCT, QED, Mixed	Countries: Small* Low-income settings: Moderate*	Mixed
	Shared book reading	Moderate	RCT, QED, Mixed	Countries: Small Low-income settings: Moderate	High
Sing-song lessons, recitation and choral lessons are common	Phonological games	Very small	RCT, QED	Countries: Very small Low-income settings: Very small	High
	Systematic phonics	Very small	QED	Countries: Very small* Low-income settings: Very small*	Cannot be inferred
Peer tutoring and supporting a buddy are common	Reciprocal teaching	Small	QED, Mixed	Countries: Small* Low-income settings: Small*	High

Notes: 1. Colour codes give strength of evidence from high-income countries (dark blue – large/consistent body of evidence; light blue – large/not always consistent; no colour – mixed); 2. For criteria for each parameter see the beginning of this chapter

Table 9.2: Strength of evidence for interventions in the early grades: responding to local context and teacher training

Current teaching-learning situation in developing countries	Intervention[1]	Strength of Evidence from developing countries[2]			
		Size	Research designs	Contexts	Consistency
Responding to local context					
Children have low spoken language proficiency in the language of instruction, low reading comprehension and low creative writing skills	Supporting emergent literacy	Moderate	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	High
	Oral language inputs	Moderate	RCT, QED, Mixed	Countries: Moderate* Low-income settings: Small*	High
A cultural and linguistic gap between child's home and school	Drawing on home experiences	Small	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	Mixed
For teacher training					
Many teachers are entrenched in prescriptive/directive ways of instruction that are neither engaging nor effective	Demonstration of interactive processes that promote practical experiences and exploration by the child	Moderate	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	High
	Support with lesson plans	Small	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	High
	Support with alternative ways to use teaching aids	Small	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	High
	Demonstration of techniques to scaffold child's learning	Moderate	RCT, QED, Mixed	Countries: Small* Low-income settings: Small*	High

Notes: 1. Colour codes give strength of evidence from high-income countries (dark blue – large/consistent body of evidence; light blue – large/not always consistent; no colour – mixed); 2. For criteria for each parameter see the beginning of this chapter

9.1 Theory of change (ToC) models

Good ToC models are an articulation of the ways in which a proposed intervention can bring about specific change (e.g. Keystone, 2008 p. 18; DFID, 2012 p. 6). Such models are useful for planning, implementation and evaluation of the effectiveness of an initiative. ToC models also offer a framework for considering reasons for delays in or changes from expected outcomes in a transparent way. For present purposes, the ToC must draw out the links between enabling conditions, a comprehensively articulated intervention and the expected outcomes related to advancing literacy and mathematical reasoning skills and knowledge in children. Most importantly, theoretically grounded ToC models can give assurance to practitioners that their interventions are built on the most effective methods (currently available) to support children's learning.

The following ToC models are based on the current theoretical understanding of literacy and foundation learning. The Intervention column in Model 1 (Figure 9.1) gives the details of what can be done to support literacy learning in the early and later grades. Model 2 (Figure 9.2) gives intervention details for supporting mathematical reasoning and numeracy learning in early childhood education and Grades 1 and 2.

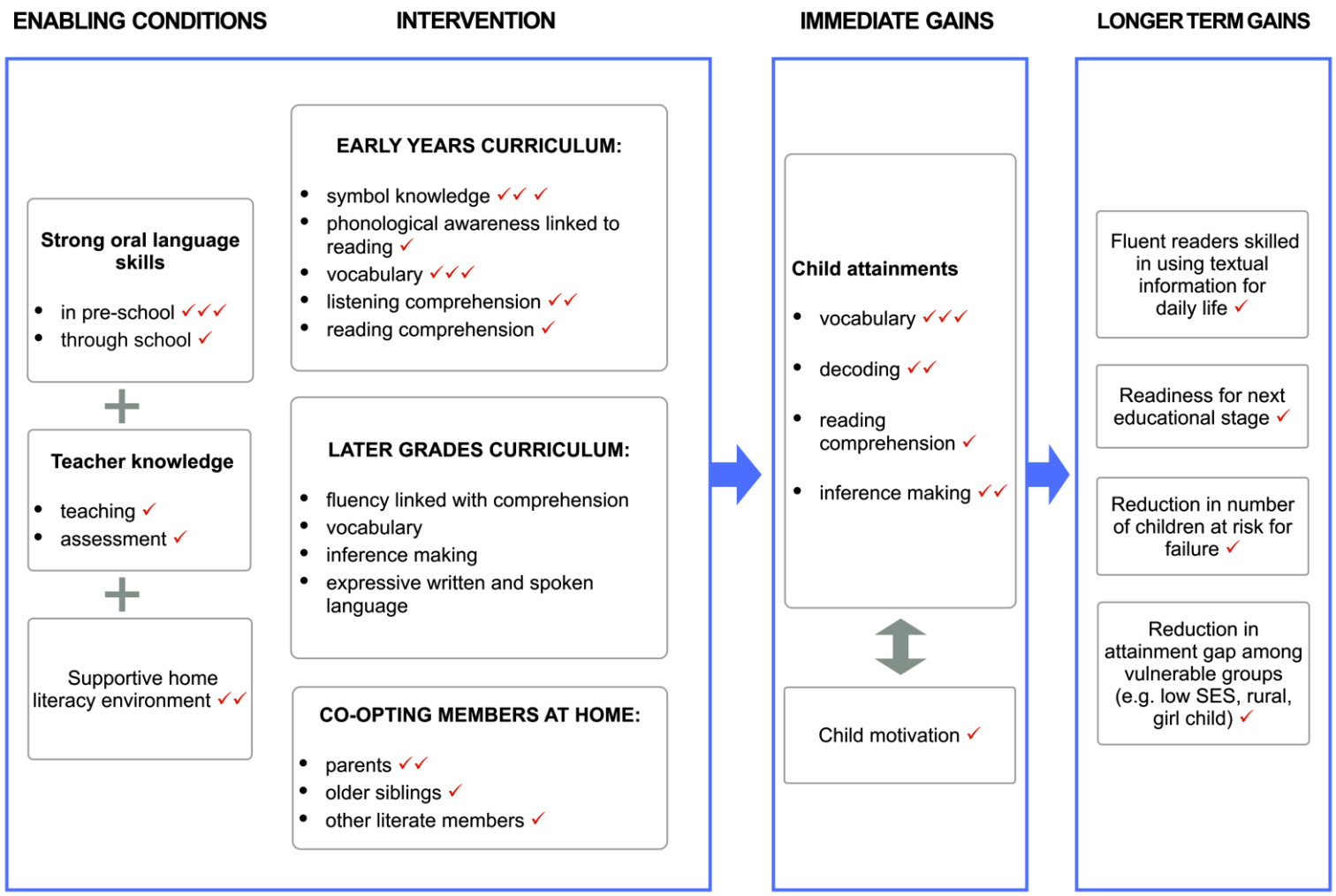
The models are also informed by the challenges to implementation. First, reform in curricula has been shown to be insufficient when there are challenges to programme fidelity, as new teachers need to learn, and agree to, the changes being introduced. Second, reform may be introduced through rewriting the curriculum, textbook revisions or new waves of professional development for teachers, but these do not give guarantee of actual change in classroom practice. Third, culturally embedded tasks and 'real life' situations improve interest and support learning, but it is not always clear what qualifies as culturally embedded and what 'real life' is, and if the tasks can be made significantly so for all children in a class. Finally, the possible problems that the ToC models might encounter are illustrated by the comments of a researcher in the process of introducing an oral language programme in schools for low-income families:

> 'The major implementation challenges we've been facing concern time pressure (teachers spend an incredibly short time in the classrooms with students), the organisation of their timetable, and classroom heterogeneity (it's difficult to motivate all students, and usually the good ones prevail).' Puglisi, São Paulo, Brazil.

Clearly, apart from changes being made to intervention programmes per se, there is a need to address the larger ecology of children's motivations, school structures and teacher knowledge and skill.

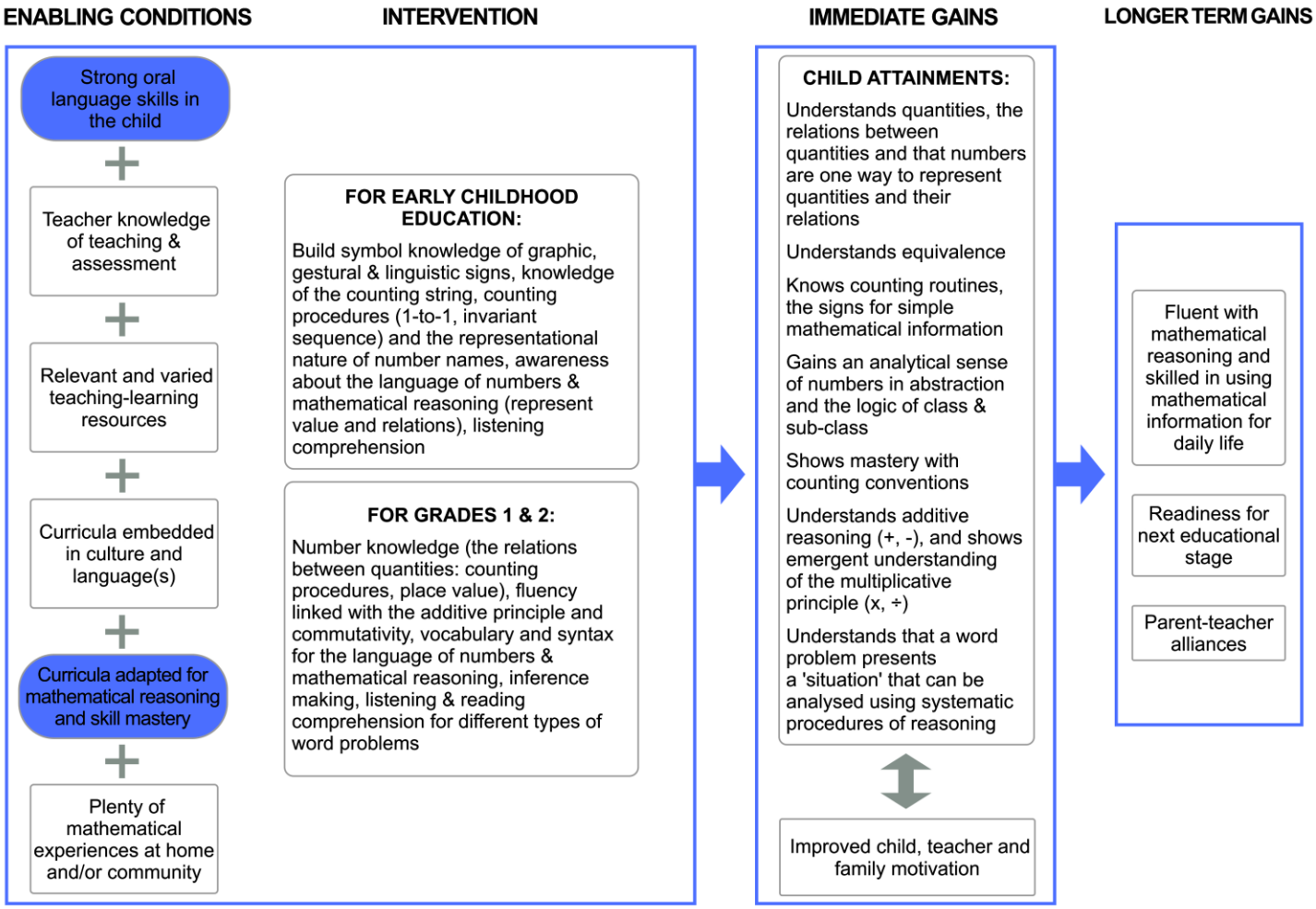
Both models make a connection between specific teaching activities and the expected gains in learning and motivation of children as well as other stakeholders.

Figure 9.1: Model 1: Theory of change model for language and literacy learning



Note: **Size of evidence from low-income contexts in developing countries:** ✓ Very small (<3 studies) ✓✓ Small (4–6 studies) ✓✓✓ Moderate (7–12 studies)
Assumptions: a) Relevant and varied teaching-learning resources. b) Curricula embedded in culture & language(s). c) Curricula adapted for inference making.

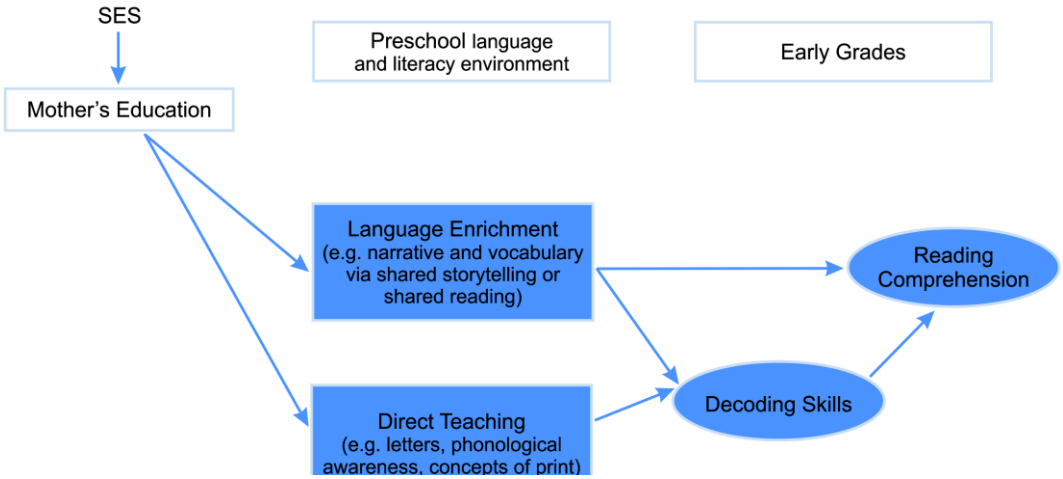
Figure 9.2: Model 2: Theory of change for mathematical reasoning and numeracy learning



Note: All intervention areas are important elements but not independently sufficient for improving mathematical reasoning attainments.
= necessary but not sufficient for immediate and longer term gains.

The assumptions and enabling conditions mentioned in the theory of change models are at the micro-, meso- and macro-levels, but are limited mainly to the educational domain. There are other factors that are also clearly crucial. For example, a set of five studies give a consistent and high-quality body of evidence that child labour is associated with lower literacy and numeracy attainments of children in developing countries.[29] In addition, there is a robust body of evidence that the lack of access to credit, and the lack of complete information about the costs and benefits of education, play an important role in holding back children from acquiring the skills they need (including literacy and numeracy) to succeed in the labour market.[30] A gender gap[31] and urban-rural gap are also reported to be associated with lower attainments, though each interacts with other social stratifiers to make a child more or less vulnerable to low levels of attainment. Moreover, the quality of health care, particularly pre-natal health care, can influence preschool cognitive development and hence the oral language skills in place at the time of school entry. While the current review did not include the literature on development from infancy through to age 3, Figure 9.3 offers a conceptual model of the critical role of language for literacy straddling the preschool years when home environment is at the fore, and the early school years.

Figure 9.3: Conceptual model of the impact of early language on later literacy



In short, it is clear that each country and each geographical area within each country will need to adapt the ToC Models we suggest to adequately cover all such additional micro-, meso- and macro-level factors. In other words, the ToC Models are a broad starting point with only the specific intervention and educational factors spelled out; further fine tuning must occur at the local level to ensure that the ToC is reflective of local complexities to be truly strategic.

[29] Gunnarsson et al., 2006 ↑; Haile and Haile, 2012 ↑; Moyi, 2011 →; Nankhuni and Findeis, 2004 ↑; Zabaleta, 2011↑

[30] For example, Adhvaryu and Nyshadham, 2012 ↑; Ahmed and Arends-Kuenning, 2006 →; Handa, 2002 ↑; Hyder et al., 2012 →; Kingdon and Theopold, 2008 ↑; Lavy, 1996 ↑; Ravallion and Wodon 1999 ↑; Sukontamarn, 2013

[31] For example, cultural norms about the role of women in society, the purpose of education, and fathers' beliefs about their daughters' education have an impact on girls' school experiences (Ghana: Stephens, 1998 →; Zambia and Malawi: Williams, 1993 →; Pakistan: Farah, 1991 →; Mexico: Azuara, 2009 ↑; 41 countries: Chiu and Chow, 2010 ↑). Such demand-side factors reduce female participation in education.

10. Gaps in the literature

10.1 Evidence of high quality

In order to produce a robust review, our focus has necessarily been on evidence of moderate quality or better. Research characterised by small sample size, lack of rigorous controls or use of measures of poor reliability accounts for much that was excluded. There is therefore a bias towards studies that have been conducted by better-funded researchers and often through the lens of schooling in the West. We believe that there are key messages to be learned from some of the research rated as low-to-moderate in quality, and consideration might be given to trawling this body of work, in particular for examples of good practice which have been found acceptable by local communities and which therefore hold promise. More generally, there are many examples of local research which are valuable but not well documented and which therefore invite replication.

10.2 Contextual factors

The choice of language for literacy and instruction was beyond the scope of this review. However, in-depth analysis of the factors that affect attainment in the language of instruction in relation to language type, the transacted curriculum, teachers' proficiency in the language of instruction and the nature of the ambient language spoken by the majority is warranted. Moreover, well-controlled, comparative studies of mother tongue versus other language of instruction are required that take into account contextual factors that moderate outcomes, including socio-economic status, geography, gender, home language and literacy environment and teacher expertise.

Countries, and within countries, schools, differ in resources available (e.g. teaching-learning materials, classroom infrastructure, libraries), level of teacher training and class size. Development of interventions clearly must be responsive to these additional contextual challenges.

10.3 Within-child factors

The review has revealed that school effects are particularly strong in developing countries, suggesting deep inequalities in learning support for children. In addition, there are large within-class variations in children's attainments. This is perhaps because much is left to the child's incidental learning, and those children who can make inferences independent of the teacher's explanation are able to pull ahead, leaving others far behind in a downward spiral of low attainment, low motivation across the curriculum and increased likelihood of dropping out. Systematic research on the interactions between within-child factors (e.g. language, inferencing skills) and attainments in different learning environments is called for, as well as studies of how children's own motivations relate to the growth of literacy and numeracy skills. In short, studies of child-curriculum interactions need attention.

An important issue to arise from the review relates to the effects of multilingualism, and in particular, the transfer of skills from one language to another. Indeed, most of the papers in our review focused on children with a home language (L1) that was different from the language of instruction (LoI). There are still many questions to answer concerning the factors that affect the ease of transfer from L1 to LoI, including: at the linguistic level, the types of languages concerned; and, at the child level, cognitive and language skills and frequency of usage. A greater focus should be given to the assessment of language and literacy in the home language and transfer to the language of instruction, as well as to ethnographic studies examining how literacy is gained in the child's home language. Another important gap is in the impact on literacy instruction provided in the language of the child when that language is marginalised. It is unclear whether there are

specific components in such initiatives for endangered and marginalised languages that make them more successful.

10.4 Assessment

Assessment procedures with good psychometric properties (reliability, validity) are required in order to support an effective education system. Such assessments are required to examine skills at baseline (in preschool or at school entry), to monitor children's progression, to ensure that teaching and curricular demands are at the right level, and to identify children with special learning needs. However, it is important that the assessment tasks used are *relevant* both for the language of instruction and for the context in order to ensure face validity; a simple translation (adaptation) of tasks can miss important information. The review was only able to make a start at identifying the issues surrounding assessment, and more research is badly needed to build on what is available and to develop new assessment procedures that are relatively quick and easy to use and where the costs are justified by the benefits.

There is currently a striking absence of good tools for the assessment of reading comprehension skills; while assessment of word-level decoding and fluency skills is relatively easy, many current measures of reading comprehension are confounded by reading accuracy. Little attention has been paid to the assessment of writing (including spelling), though this is perhaps the cheapest form of assessment. Likewise, in the domain of mathematical reasoning and numbers, assessments focus only on basic arithmetic skills and not on problem solving.

More fundamentally, measures of oral language are lacking, such as assessments of the ability to define words (vocabulary depth), grammar (e.g. sentence repetition), narrative and listening comprehension (e.g. story retelling).

Finally, there is a need for high-quality teacher-administered tools and observational methods that are attuned to children's learning needs and learning profiles.

10.5 Evidence about interventions

We need to acknowledge that there are many innovative interventions available in developing countries (e.g. those rolled out by some NGOs), but they are not represented in our review, either because they have not been evaluated using a randomised controlled trial or a quasi-experimental design, because the quality of any such evaluations falls short of our criteria for inclusion, or because it is difficult to access their quality because of the absence of sufficiently detailed documentation. We recognise the potential of local innovations and suggest that they should inform future studies.

The review revealed that teaching of phonological skills shows promise. Here, adaptations of existing programmes using low-cost materials that take account of cultural context would be timely. In addition, these programmes could be delivered in conjunction with activities to promote reading fluency and reading comprehension, perhaps co-opting literate members at home and the community. Arguably, the most significant gap in the review pertains to reading comprehension. Reflecting teaching practice in broad terms, no evaluations of comprehension programmes were found. Moreover, questions remain as to the way proficiency in the language of instruction moderates gains. Our review did not identify studies of interventions in multilingual classroom contexts, and therefore cannot address how best to implement oral language interventions in such contexts. Such questions warrant attention.

11. Future directions

The review has revealed a wide range of gaps in the literature from developing countries. Arguably, however, there is sufficient evidence of synergies between what has been found and current knowledge from high-income countries to recommend prioritisation of intervention studies. The advantage of such studies is that they can provide evidence of causal relationships between within-child and environmental factors and educational outcomes. It is essential however, that such studies be pedagogically sound, given current theories of literacy and numeracy, rather than pragmatic evaluations of existing/commercial programmes.

11.1 Methodology

The gold standard for controlled evaluations of interventions is the RCT. However, sometimes the assumption is made that the intervention can be implemented and monitored in ideal conditions and this is often not the case. The challenges in developing countries can be particularly daunting because class sizes might be very large, teaching periods easily disrupted and student attendance rates poor.

Nonetheless, we believe that efficacy RCTs should be used as a necessary preliminary step prior to the implementation of larger effectiveness field trials using both RCTs and QEDs. Within these trials, 'response to treatment' should be monitored at the level of the child and the influence of school-level factors ascertained. For this to be possible, reliable pre- and post-intervention measures need to be selected and, in many cases, developed for use.

Our tentative recommendations are:

1. Small-scale development studies are required to pilot intervention materials targeting component literacy/numeracy skills with appropriate cultural material
2. Once proof of principle is established, a series of cluster RCTs in different communities, where these are already known to be feasible, is recommended, followed by meta-analysis of effect sizes if the interventions and outcomes are sufficiently homogeneous. Ideally alternative treatment designs might be considered (e.g. literacy versus numeracy interventions; phonological training versus morphological training)
3. Once efficacy is established, RCTs and QEDs need to be run to establish effectiveness through an investigation of the predictors of individual differences in pupils' response to intervention, examination of school-/class-level factors, and interactions between pupil characteristics and the class-level characteristics. Such designs lend themselves to longer-term tracking.
4. In some situations, where only a section of the class require intervention (e.g. where the language of instruction is L2, children with no literate member in the household), regression discontinuity designs could be considered. Here the idea is to follow up the whole class over time and to assess 'catch up' of the targeted sub-group.
5. If sample sizes are sufficient, regression discontinuity designs could be extended to follow attainments in schools/communities which receive intervention versus others in which there is no intervention. It would be important to establish 'equivalence at baseline' and ideally to track development for some time before and after the intervention was implemented.

While the research team have some methodological expertise, none is a statistician and expert advice is warranted regarding the validity of this proposal, and estimations of statistical power are desirable.

In summary, our research design of choice would be a multi-country RCT evaluating interventions derived from the ToC models we propose. It would be important to have very good measures of school-level factors (including quality of resources, environments and teaching) in order that they can be assessed using appropriate forms of statistical analysis to examine the interactions between types of intervention and types of learning environment.

Such a study would need to address a number of key issues. The difficulties of implementing and interpreting the findings of well-controlled interventions in resource-poor settings are considerable. Questions need to be answered about how best to maintain the fidelity of programmes that are introduced to support the development of literacy and numeracy, and in particular, how to develop home-school alliances to improve pupil attainments. One promising way forward could be to enlist the support of older (and more educated) siblings as mediators in this partnership as well as to enlist their support with the delivery of home tutoring.

Second, there is a need (emphasised in the Assumptions and Enabling Conditions in the models) to integrate interventions with local cultural practices. For example, literacy instruction may be integrated with local sound games and use of the rich oral traditions of each of the communities observed. These practices have been offered as indigenous ways of training in phonological awareness (e.g. Patel, 2004, for the Indian languages) and are embedded in the ways of living in many developing countries (e.g. see Ngara, 2007 for African countries). It is plausible that the roots of choral practice are cultural, and this needs serious research attention. Instead we found reference to how 'western' programmes were stamping out indigenous methods (e.g. Azuara, 2009 ↑; de la Piedra, 2006 ↑ , Mount-Cors, 2011 →) and the need for materials entering the classroom to have greater cultural resonance.

Once proof of principle is established through a robust trial, then successful interventions can be scaled up and monitored, taking into account the processes of enculturation and acculturation.

Not included in this review is the **role of teacher training**, but there is good evidence from this area that pre-service courses are failing to skill new teachers with methods that teach for meaning and understanding (e.g. Akyeampong et al., 2013 ↑). It is critical that teachers understand the componential nature of both literacy and numeracy if they are to engage with curriculum change. Such lacunae are in urgent need of attention.

12. Conclusion

This review has brought together a rich set of studies addressing literacy and foundation learning in developing countries using a variety of methodologies. The convergence of findings with those from high-income countries is remarkable and highlights the importance of acknowledging that educational success builds on language skills. It follows that great care needs to be taken when considering the educational needs of children growing up in multilingual communities where they may not speak the language of the classroom. While learning to decode print might proceed regardless, children will not be able to read with understanding or be ready for the next stage of education if attention is not paid first to language and second to strategies to develop reading comprehension. Similarly, they may bring to school an intuitive sense of number and even mathematical reasoning, but they will not be able to become numerate without a language within which to learn about and to solve mathematical problems. Therefore, a high priority for education in developing countries is to augment the emphasis on learning sight words, arithmetic facts and writing routines with a focus on the development of component skills of reading, writing, inference making and mathematical reasoning. For many children, a prerequisite will be that attention be paid to oral language proficiency. In order to bring about such change, we argue that it is an imperative that culturally embedded approaches to learning are respected, and where possible, indigenous methods are assimilated into new curricula. The most efficient way of doing this is likely to be by co-opting teachers, parents, older siblings and supports in the community to work with professionals to design new and theoretically underpinned curricula.

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(papers in the review have an asterisk *)

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Appendices

Appendix 1: Authorship and acknowledgements

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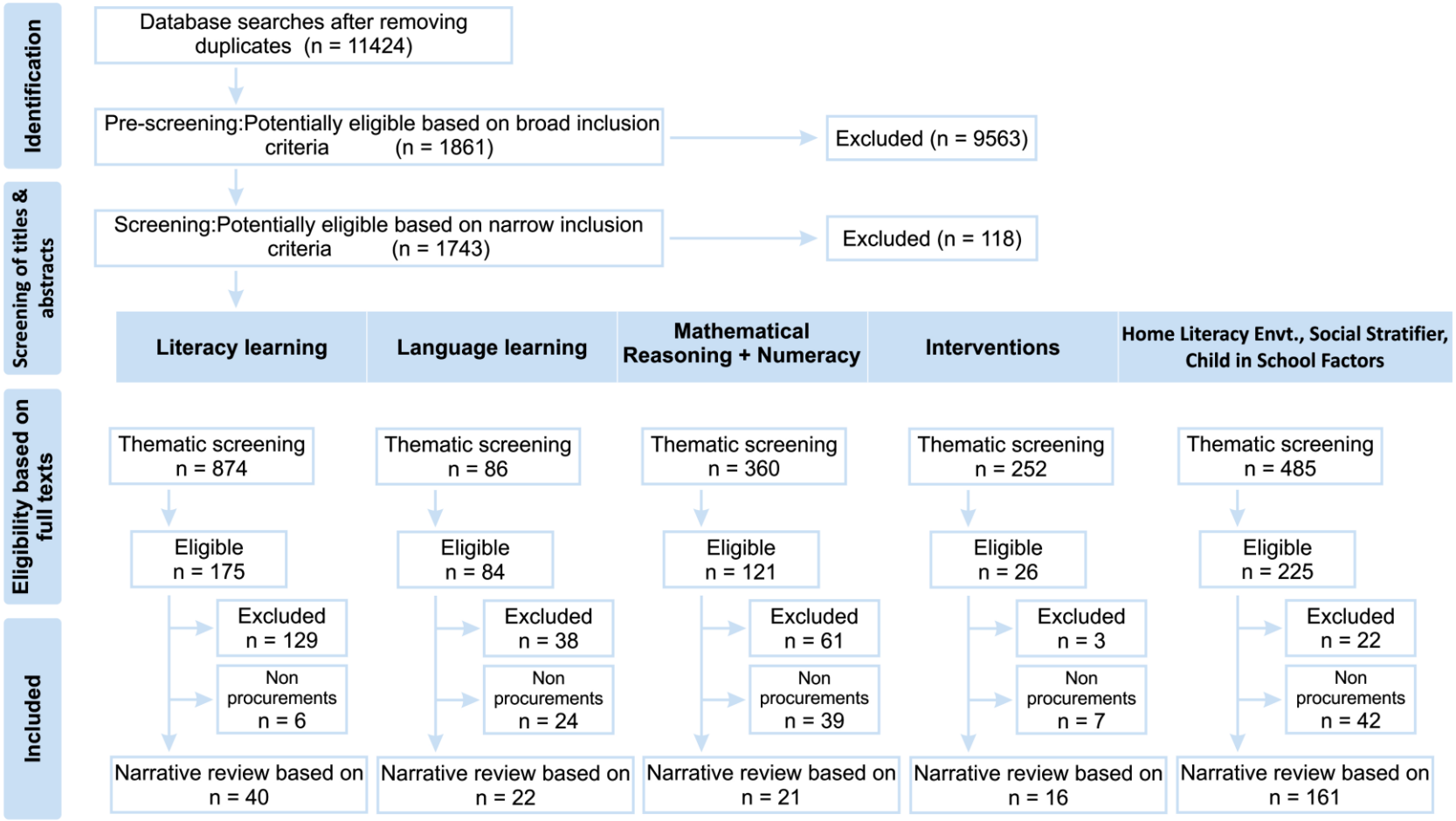
Appendix 2: Flow diagram showing the process leading up to inclusion of papers in the narrative review



Appendix 3: Map of included ethnographic studies on classroom practices related to language and literacy learning

Country	Paper, QR[1]	Sample, MI[2]	Stratifiers	Key literacy practices
Ethiopia	Cianca, 2012 ↑	G3, one school, biL	urban 'budget' school	Classes follow same routine. Children read in unison following teacher, copy writing from board, there is individual feedback by teacher on written work.
Eritrea	Asfaha and Kroon, 2011 →	G1, nine schools, MI in L1 MI in L2 (Arabic)	urban, rural	Chanting, memorisation games, recitations and repeated exercises are common. Drilling is of decoding and writing skills and focus is on memorising the letters or word spellings.
Ghana	Akrofi, 2003 →	One G1 class, 5 sets of parents and children MI in L2 (English)	urban	At home, parent's model literacy practices after teachers' practices. In school, learning is mainly from writing on the blackboard; there are not many books to read. Strict use of the prescribed book rather than alternatives such as story books.
India	Dyer, 2008 ↑	Primary teachers MI is L1 for most children	urban and rural	Few learning aids in class. In response to errors, children are asked to practice through repetition. Peer tutoring noted.
	Saigal, 2012, ↑	1 primary teacher, single teacher school MI is L1 for most children	rural	Some emphasis on rote learning. Very few instances of storytelling and children re-constructing stories. Group work common.
Kenya	Mount-Cors, 2011 →	Mothers with limited literacy and with children in Grade 2 Children in three schools MI = biL	semi-urban and rural	Mothers give literacy support by visiting schools often to check on children's performance; mothers make sure children's health is fine to attend school regularly.
Mexico	Azuara, 2009↑	Case study of one child and community MI = L2	indigenous community	Writing assignments, copy writing practice multiple times, newspapers, watching older siblings using literacy tools.

Country	Paper, QR[1]	Sample, MI[2]	Stratifiers	Key literacy practices
	Azuara and Reyes, 2011↑	Case study of one child MI = L2	indigenous community	Drill of 'isolated features', reading syllables, copying, choral and round-robin reading, little reference to child's L1.
Pakistan	Farah, 1991 →	Preschool to G5, 1 girls' school. MI = biL	gender, rural	Recitation and memorisation, copying practice - one leads and others repeat.
Peru	de la Piedra, 2006 ↑	Small village community MI = L2	rural	Decoding efficiency is valued over comprehension; group work is common, as is teaching each other and copy writing.
	de la Piedra, 2010 ↑	Small village community MI = L2	rural	Key ways to deal with textual materials include memorising, copying, writing practice, highlighting key sentences and collective reading.

Notes: 1. QR = Quality ratings; ↑ = moderate-high and high quality; → = moderate quality; 2. MI = Medium of instruction in school, L1 = child's home language, L2 = a second (or third) language, biL = biliteracy

Appendix 4: Map of included ethnographic studies on classroom practices related to mathematical reasoning and numeracy

Country	Paper, QR[1]	Sample, MI[2]	Stratifiers	Key numeracy practices
India	Guha, 2006 →	Teachers in early childhood settings MI in L2 (English)	urban, varying in socio-economic status	Mathematics was an important part of the curriculum. Classes were held 4-5 times a week in 30- to 40-minute sessions. Several locally sourced learning aids were observed in class. Counting strategies predominantly used the Indian style of finger counting. Alternative counting strategies were with local materials like marbles, pebbles and seashells.
Indonesia	Rumiati and Wright, 2010 ↑	1st and 2nd graders MI in L1	urban, a co-educational Islamic-based private school	Multiple strategies for simple one-digit additions were recorded among observed children. Some strategies were taught in school, others by parents at home, and still others were learned in the local community. Multiple ways of using finger counting were noted, including the teacher taught counting-on method and *Jarimatika or Chisanbop* (an abacus-like method). Some children seemed to be confused by the different methods they had been exposed to; one child settled on her 'mother's method' as the best, even though this sometimes returned wrong results.
Pakistan	Farah, 1991 →	Preschool to G5, 1 girls' school MI in L2 (Urdu, Arabic)	gender, rural	Number names were called out in Urdu and written in 'English'. There was no mathematics textbook, all practice was on a slate hence impermanent, mental mathematics was encouraged, recitation and memorisation of number facts was common, as was copying practice and a lot of child-to-child learning, where one led and others repeated. Parents expected practical number skills ('someone to read the bills to me' p. 79) but it is not clear that children were getting such skills in school.
Zimbabwe	Cleghorn, et al., 1998 ↑	Early grade class, classroom observations. MI in L2 (English) (Data only from Zimbabwe	urban	The classroom teaching environment was more 'strictly teacher-centred' and less 'modified learner-centred'. There was a general reliance on rote instructional methods and on memorisation of disconnected facts for examinations, 'a teaching approach that emphasizes facts, at the expense of process'. Teachers' explanations began to include the children's home language, but only 'as the lesson winds down'; the main body of the lesson was

Country	Paper, QR[1]	Sample, MI[2]	Stratifiers	Key numeracy practices
		extracted)		in the language in which children were less proficient.

Notes: 1. QR = Quality ratings; ↑ = moderate-high and high quality; → = moderate quality; 2. MI = Medium of instruction in school, L1 = child's home language, L2 = a second (or third) language

Appendix 5: Included intervention studies: country profiles[32]

Bangladesh

According to data from the 2007 Demographic and Health Survey (DHS), 57.8 per cent of people in Bangladesh are poor. This headcount ratio was calculated using the Oxford Poverty and Human Development Initiative (OPHI)'s Multidimensional Poverty Index (MPI). The MPI takes into account multiple indices of deprivation, including access to education and health services. It uses three dimensions and 10 indicators to determine whether or not someone is living in poverty. The World Bank classifies Bangladesh as a 'low income' country.

According to UNESCO statistics, 57.7 per cent of people over the age of fifteen in Bangladesh are considered literate; youth literacy, aged 15-24, is even higher at 78.7 per cent. In 2009, Bangladesh spent 2.2 per cent of its Gross Domestic Product (GDP) on education (CIA World Factbook). This spending ranked Bangladesh as 163 out of 173 countries. The *Social Sector Performance Survey* on Bangladesh's primary school system, commissioned by DFID, states that nearly 90 per cent of the revenue budget from the Ministry of Education for primary education is spent on teacher salaries. Bangladesh receives nearly 2 billion USD in foreign aid per year (Melik, 2009).

A 2006 estimate showed that 13 per cent of children aged 5-14 were engaged in some sort of employment (CIA World Factbook). The World Factbook defines 'child labor' as:

> work that deprives children of their childhood, their potential, and their dignity, and that is harmful to physical and mental development. It refers to work that is mentally, physically, socially, or morally dangerous and harmful to children. Such labor may deprive them of the opportunity to attend school, oblige them to leave school prematurely, or require them to combine school attendance with excessively long and heavy work. In its most extreme forms, child labor involves children being enslaved, separated from their families, exposed to serious hazards

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and illnesses, and/or left to fend for themselves on the streets of large cities – often a very early age.

According to statistics from the *Social Sector Performance Survey* on Bangladesh's primary school system, 97 per cent of children aged 6-10 are enrolled in primary school. This indicates that child labour may not be a barrier to enrolling in primary school; however, only 60 per cent of children enrolled actually finish primary schooling (Sabates et al., 2010), indicating that dropout is a substantial problem.

Costa Rica

World Bank statistics classify Costa Rica as an 'upper middle income' country with a headcount ratio of 20.6 per cent of the population at the national poverty line. This measure does not, however, take into account the MPI methodology and may actually be understating the incidence of deprivation.

According to UNESCO statistics from 2011, 96.3 per cent of people over the age of fifteen are considered literate; youth literacy, aged 15-24, is slightly higher at 98.3 per cent. In 2009, Costa Rica spent 6.3 per cent of GDP on education, ranking it 32 out of 173 countries (CIA World Factbook). In the same year, this expenditure accounted for 23.1 per cent of total government spending (UNESCO Institute for Statistics).

Five per cent of children aged 5-14 were engaged in child labour in 2002 (CIA World Factbook). Since 2009, school dropout has become more of a problem in Costa Rica. The Ministry of Education reported that dropouts increased from 10.2 to 11.1 per cent between 2010 and 2011, with most occurring at the secondary school level.

Kenya

Data from the 2009 DHS using the MPI methodology showed that 47.8 per cent of people were living in poverty (OPHI). Of the entire population, nearly 20 per cent were living in severe poverty. The World Bank classifies Kenya as a 'low income' country.

According to UNESCO statistics from 2007, 72.2 per cent of people over the age of 15 are considered literate; youth literacy, aged 15-24, is even higher at 82.4 per cent. In 2010, the Kenyan Ministry of Education, Science and Technology spent the equivalent of 6.7 per cent of GDP on education. In 2011, this comprised 13.5 per cent of the total government budget (Kenya National Bureau of Statistics).

An estimate from the year 2000 showed that nearly 25 per cent of children aged 5-14 were engaged in child labour in Kenya, indicating that the prevalence of child labour might pose a significant challenge to education in the country (CIA World Factbook). In 2011, the net enrolment ratio at the primary school level was 95.7 per cent; however, enrolment varied greatly on a regional basis (Kenya National Bureau of Statistics). Data from the Kenyan Ministry of Education indicate that between 2004-2006, 6.1 per cent of children in primary school had to repeat a grade and nearly 5 per cent dropped out of primary education (Otieno and Colclough).

India

Data from the 2009 DHS using the MPI methodology showed that 53.7 per cent of people were living in poverty (OPHI). Of the entire population, nearly 30 per cent were living in severe poverty. Despite this, the World Bank classifies India as a 'lower middle income' country.

According to UNESCO statistics from 2006, 62.8 per cent of people over the age of 15 are considered literate; youth literacy, aged 15-24, is even higher at 81.1 per cent. In 2010, India spent the equivalent of 3.3 per cent of its GDP on education, ranking it 131 out of 173 countries (CIA World Factbook). This accounted for 10.5 per cent of the government's budget in that year (UNESCO Institute for Statistics).

The World Bank estimated that 93 per cent of Indian children were enrolled in primary school in 2010. The government has recently implemented a program, *Sarva Shiksha Abhiyan* (SSA), targeting the universalisation of education in the hope of increasing access to and enrolment in primary education. Dropout rates are high in primary schooling in India, with only 60 per cent of pupils lasting past Grade 5 (UNESCO Institute for Statistics). In 2006, an estimated 12 per cent of children aged 5-14 were involved in child labour (CIA World Factbook).

Indonesia

World Bank statistics classify Indonesia as a 'lower middle income' country. According to the MPI headcount ratio based on 2007 DHS data, 20.8 per cent of people live in poverty; 7.6 per cent of people live in severe poverty (OPHI).

According to UNESCO statistics from 2009, 92.6 per cent of people over the age of 15 are considered literate; youth literacy, aged 15-24, is even higher at 99.5 per cent. In 2010, Indonesia spent 3 per cent of GDP on education, ranking it 141 out of 173 countries (CIA World Factbook). This accounted for approximately 15 per cent of the government's total expenditure (UNESCO Institute for Statistics).

Seven per cent of children aged 5-17 were engaged in child labour in 2009 (CIA World Factbook). In 2011, UNESCO estimated that the regional average of children enrolled in primary school was 96 per cent, indicating that enrolment varies significantly on a regional basis.

Morocco

According to data from the 2004 Demographic and Health Survey (DHS), calculated using the MPI, 28.5 per cent of people are poor. The World Bank classifies Morocco as a 'lower middle income' country.

According to UNESCO statistics, 56.1 per cent of people over the age of 15 are considered literate; youth literacy, aged 15-24, is even higher at 79.5 per cent. In 2009, Morocco spent 5.4 per cent of its GDP on education (CIA World Factbook). This spending placed Morocco 111th out of 173 countries.

A 2007 estimate showed that 8 per cent of children aged 5-14 were engaged in some sort of employment (CIA World Factbook). UNESCO statistics show, however, that 96 per cent of children are enrolled in primary school, with a primary to secondary transition rate of 83 per cent.

Philippines

According to the MPI headcount ratio based on 2008 DHS data, 13.4 per cent of people live in poverty; 5.7 per cent of people live in severe poverty (OPHI). World Bank statistics classify the Philippines as a 'lower middle income' country.

Statistics from UNESCO collected in 2008 show that 95.4 per cent of people over the age of 15 in are considered literate; youth literacy, aged 15-24, is even higher at 97.8 per cent. In 2010, the Philippines spent 2.7 per cent of GDP on education, ranking it 151 out of 173 countries (CIA World Factbook). This accounted for 15 per cent of the government's total expenditure (UNESCO Institute for Statistics). Of the money allocated to education, the government spent 56 per cent of it on primary education, which is significantly higher than all other countries dealt with in this section of the review.

Statistics from the 2011 Survey on Children by the government of the Philippines show that 18.9 per cent of children aged 5-17 were considered to be working (National Statistics Office of the Philippines). The definition includes any child who worked for at least one hour over the previous 12 months, which is different from the previously defined 'child labor' statistics presented for the other countries. In 2011, UNESCO estimated that the

regional average of children enrolled in primary school was 96 per cent, indicating that enrolment varies on a regional basis.

Sri Lanka

Data from the 2003 World Health Survey (WHS) used by OPHI to calculate the MPI poverty headcount returned a value of 5.3 per cent, with 0.6 per cent in severe poverty (OPHI). The World Bank classifies Sri Lanka as a 'lower middle income' country.

In 2010, Sri Lanka spent the equivalent of 2 per cent of GDP on education, ranking it 166 out of 173 countries (CIA World Factbook). In 2011, education spending comprised 12.9 per cent of the government's total budget (UNESCO Institute for Statistics).

According to UNESCO statistics, 62.8 per cent of people over the age of 15 are considered literate; youth literacy, aged 15-24, is even higher at 80.7 per cent. The Department of Census and Statistics in the Ministry of Finance and Planning in Sri Lanka conducted a 'Child Activity Survey' in 2008-2009, which indicated that 2.5 per cent of children were involved in child labour (Department of Census and Statistics, Ministry of Finance and Planning, Sri Lanka). In 2011, 93 per cent of children were enrolled in primary school; of these children, 98 per cent would make the transition from primary to secondary schooling, indicating that primary school dropout does not pose too large a challenge (UNESCO Institute for Statistics).

Tanzania

According to the MPI headcount ratio based on 2010 DHS data, 65.6 per cent of people live in poverty; 33.4 per cent of people live in severe poverty (OPHI). World Bank statistics classify Tanzania as a 'low income' country.

In 2010, Tanzania spent 6.2 per cent of GDP on education, ranking it 34 out of 173 countries (CIA World Factbook). This accounted for 18.3 per cent of the government's total expenditure (UNESCO Institute for Statistics).

The literacy rate for the general population over age 15 was estimated to be 59.1 per cent in 2011 (UNESCO Institute for Statistics). For youth between the ages of 15-24, the literacy rate was approximately 10 percentage points higher at 69.5 per cent.

In 2006, it was estimated that 21 per cent of children aged 5-14 were involved in child labour (CIA World Factbook). This high rate of employment does affect enrolment in schooling: in 2011, UNESCO estimated that the regional average of children enrolled in primary school in Tanzania was only 77 per cent.

Turkey

Data from the 2003 DHS placed the MPI poverty headcount in Turkey at 6.6 per cent with 1.3 per cent of the population living in severe poverty (OPHI). The World Bank classifies Turkey as an 'upper middle income' country.

In 2010, Turkey spent the equivalent of 2.9 per cent of GDP on education, ranking 145 out of 173 countries (CIA World Factbook). The government's share of spending on education has increased dramatically over the past ten years from 9.4 per cent of the budget in 2002, to 17 per cent in 2013.

According to UNESCO statistics, 90.8 per cent of people over the age of fifteen in Turkey are considered literate; youth literacy, aged 15-24, is even higher at 97.8 per cent. In 2011, 95 per cent of children in Turkey were enrolled in primary school; of these children, 97 per cent make the transition from primary to secondary schooling (UNESCO Institute for Statistics). In Turkey, an estimated 3 per cent of children between the ages of 6-14 are engaged in child labour (CIA World Factbook).

Uganda

According to the MPI headcount ratio based on 2011 DHS data, 69.9 per cent of people live in poverty; 38.2 per cent live in severe poverty (OPHI). World Bank statistics classify Uganda as 'low income'.

In 2012, Uganda spent 3.3 per cent of GDP on education, ranking it 134 out of 173 countries (CIA World Factbook). This spending accounted for 17.2 per cent of the government's total expenditure (UNESCO Institute for Statistics).

The literacy rate for the general population over age 15 was estimated to be 71.4 per cent in 2006, with considerable regional variation (UNESCO Institute for Statistics). For young people between the ages of 15 and 24, the literacy rate was over 10 percentage points higher at 84.1 per cent.

In 2010, it was estimated that 25 per cent of children in Uganda aged 5-17 are involved in child labour (CIA World Factbook). UNESCO estimated that in 2011, 94 per cent of children were enrolled in primary school in Uganda, again with significant regional variation.

Appendix 6: Map of included RCTs showing quality of evidence

Author, date, Overall quality, country, sample	Intervention	Results	Weight of evidence: methodological quality; cultural sensitivity
Abeberese, et al., 2011 →, Philippines Grade 4	Provision of age appropriate reading materials and 31-day reading marathon. Sa Aklat Siskat Reading Program	Significant increase in propensity to read; improvement on reading assessment (immediate post-test and long-term follow-up)	Moderate Moderate
Banerjee et al., 2007 → [first randomised experiment], India Grades 3 and 4	Remedial education (basic literacy and numeracy) using young women from the local community as teachers. Balsakhi Program	Substantial positive effect on academic achievement in language and mathematics; some evidence that the weaker children gained most from the intervention	Moderately-high Moderately-low
Banerjee et al., 2007 → [second randomised experiment], India Grade 4	Computer-assisted learning programme focusing on mathematics	Significant positive effects on mathematics scores	Moderate Moderate
Borkum et al., 2011 → India Primary school children	Primary school library programme. The Akshara Library Program	The programme had no effect on student scores on the language tests (reading, grammar, punctuation, vocabulary)	Moderate Low
Borzekowski and Henry, 2011, ↑ Indonesia Preschool, ages 3-6	Four-month education multimedia intervention. Jalan Sesama (Sesame Street)	Improved literacy and mathematical skills	Moderately-high to high Moderately-low
Opel et al., 2009 ↑, Bangladesh Preschool, ages 5-6	Whole-class dialogic reading intervention	Positive effect on expressive vocabulary.	High Moderate
Opel et al., 2012 ↑, Bangladesh	Mathematics intervention Adapted version of Big	Positive effects on mathematics skills	Moderately-high Moderately-high

Author, date, Overall quality, country, sample	Intervention	Results	Weight of evidence: methodological quality; cultural sensitivity
Pre- and primary school children	Math for Little Kids		
Rolla San Francisco et al., 2006 →, Costa Rica Kindergarten children	Three early literacy interventions: tutoring, classroom activities, work with families	Tutoring or a combination of all three interventions were the most effective for emergent literacy skills, while providing high-quality materials to teachers without training had no impact	Moderately-low Moderately-low

Appendix 7: Map of included QEDs showing quality of evidence

Author, date, country, quality appraisal	Age/Grade (N= sample size)	Intervention: brief details, Delivery by, Duration	Context of implementation	Outcome measures	Impact	Weight of evidence: methodological quality; cultural sensitivity
Aboud (2006) Bangladesh ↑	4.5-6.5 years Preschool (N=401)	PLAN Bangladesh (free play; stories; instruction in literacy and mathematics) By teachers Half day programme, six days a week	NGO and Plan Bangladesh run preschools in high poverty rural areas	Vocabulary, matrix reasoning, similarities, school readiness (play factors, demographic /health data)	Positive impact on school readiness, vocabulary and reasoning (though lower than would be expected)	High Moderate
Bekman et al. (2011) Turkey →	6 years (N=360)	School readiness (cognitive skills, language skills, socio-emotional development and physical competencies) Delivery by: unclear 10 week programme	Formal (public) preschools and experimental preschools of The Mother - Child Education Foundation. Both in low-income communities	Pre-literacy, pre-numeracy, vocabulary, syntactic structures and narrative	Positive impact on pre-literacy and pre-numeracy, syntactic knowledge and story comprehension	Moderate Moderate
Dixon et al., (2011) India →	Around 7 years Grade 1 (N=506)	Jolly Phonics (Synthetic phonics teaching) By peripatetic teacher 1 hour every weekday for 6 months	Private unaided English-medium schools in urban slum areas	Reading (decoding), spelling, letter recognition, sound values of letters, dictation	Positive impact on reading, spelling and decoding	High Low-moderate

Author, date, country, quality appraisal	Age/Grade (N= sample size)	Intervention: brief details, Delivery by, Duration	Context of implementation	Outcome measures	Impact	Weight of evidence: methodological quality; cultural sensitivity
Malmberg et al., (2011) Kenya, Uganda and Zanzibar/ Tanzania ↑	Preschool T1; mean age=4.3 years T2=6.0 T3=7.1 N=173 for children seen at T1, T2 and T3	Madrasa Early Childhood Development Program (values children as active learners; high-quality student-teacher interaction) MAMACHOLASU (Acronym for programme targets: MAterials, MAnipulative, CHoice, LAnguage, SUpport) By teachers with a minimum of 8 years' schooling + one year teacher training + 6 month MRC training 3 years	Madrasa Resource Centre (MRC) preschools. Control preschools run by the government, NGOs or the community	Cognitive skills (block building, verbal comprehension, early number concepts, picture similarities, verbal meaning and non-verbal reasoning tasks)	Positive impact on cognitive development	High High
Moore et al., (2008) Bangladesh ↑	Preschool (N=186)	PLAN Bangladesh ('pilot improved') (focus on informal language use, group time, free play and individual/ small-group work, more child-centred) By researcher-trained teachers 7 months programme (half days, five days a week)	NGO and Plan Bangladesh run preschools in high poverty rural areas	Cognitive skills and school readiness	Pilot preschool children made greater gains on most outcome measures including block design and matrices (but not vocabulary)	High Moderate-High

Author, date, country, quality appraisal	Age/Grade (N= sample size)	Intervention: brief details, Delivery by, Duration	Context of implementation	Outcome measures	Impact	Weight of evidence: methodological quality; cultural sensitivity
Mwaura et al., (2008) Kenya, Uganda and Zanzibar/ Tanzania ↑	Preschool Pre-test; Ages 3-6 (N=423)	Madrasa Early Childhood Development Program (values children as active learners; high-quality student-teacher interaction) MAMACHOLASU (Acronym for programme targets: MAterials, MAnipulative, CHoice, LAnguage, SUpport) By MRC teachers (minimum 8 years' schooling plus one year teacher training, plus 6 month MRC training). 18 months	MRC schools and control non-MRC schools (run by the government, NGOs or the community)	Cognitive skills (block building, verbal comprehension, early number concept, picture similarities, verbal meaning, exclusion, closure)	Positive impact on cognitive development	High Moderate-Low
Nag-Arulmani et al., (2003) India ↑	7-9 years Grade 3 (N=118)	Phonological intervention (PI); teaching through phonological activities. Language exposure intervention (LI); teaching through encouragement of spontaneous exploration of language By researcher-trained volunteer teachers (college graduates)	4 schools in Bangalore offering English as a first language	Assessments on single-word reading, reading comprehension, spelling, non-word reading, phonological skills and language proficiency	Positive effects of PI intervention on single word reading, spelling, decoding and phonological skills. Gains not rapid enough to keep pace with grade-	High Moderate-High

Author, date, country, quality appraisal	**Age/Grade (N= sample size)**	**Intervention: brief details, Delivery by, Duration**	**Context of implementation**	**Outcome measures**	**Impact**	**Weight of evidence: methodological quality; cultural sensitivity**
		10 sessions of 90 minutes conducted 3 times a week			level attainments.	
Schagen *and Shamsan,* (2007) India →	Typically around seven years Grade 1 (N=506)	Jolly Phonics intervention Synthetic phonics teaching By peripatetic teacher trained by researcher 1 hour every weekday for 6 months	Private unaided English-medium schools in slum areas	Reading (decoding), spelling, letter recognition, sound values of letters, dictation	Positive impact on reading, spelling and decoding	High Low-moderate

Appendix 8: Intervention studies targeting mothers with a view to enriching the home language and literacy environment

	Target age/ grade (sample size)	Country (Contextual-isation of intervention)	Intervention Content and duration	Implemented by	Child outcomes	Parent outcomes	Impact
Aboud, 2007→	<3 years (329)	Bangladesh (locally developed)	Psychosocial and language stimulation, health, hygiene, and nutrition. 90-minute weekly sessions to groups of ~20 mothers. Total number of sessions delivered unclear.	Trained women (facilitators) who had some secondary education. 17 days of basic training with a manual of 40 topics, 4 days a month of supervision, and monthly refresher courses	Receptive vocabulary	Mothers' knowledge about good practices for child development, Amount and quality of stimulation and support provided by mothers at home Mothers' provision of engaging verbal stimulation in a mother-child picture task	A year later: No impact on children's receptive vocabulary. Mothers in the intervention group had more positive knowledge about good practices for child development/ opportunities for stimulation in the home. Intervention compensated for lack of schooling in mothers. Intervention yielded higher scores on HOME stimulation - primarily among mothers with better resources (assets and education)
Aboud and Akhter, 2011↑	8-20 months (302)	Bangladesh (locally developed)	Psychosocial and language stimulation, health, nutrition, and child development: 12 sessions on above topics for all groups. Intervention groups: 6	Local community health workers; Intervention group sessions: peer educators were young women from the village (Grade 9 education) who were trained over 4 days to	Receptive and expressive language	Opportunities for stimulation in the home through observation and maternal interview Responsive maternal talk with child in engagement in a picture task	HOME inventory scores and mothers' responsive talk higher for mothers in the intervention groups Children's language skills higher in the intervention groups compared with controls

	Target age/ grade (sample size)	Country (Contextual-isation of intervention)	Intervention Content and duration	Implemented by	Child outcomes	Parent outcomes	Impact
			additional sessions with demonstrations and coached practice to promote responsive stimulation and feeding. One of the intervention groups also received 6 months' supply of fortified food powder.	use the 30-page manual			
Kağitçibaşi et al., 2009↑	3 and 5 year olds (255)	Turkey (Turkish adaptation of the Home Instruction Program for Preschool Youngsters, HIPPY, originally developed in Israel.)	Two-year programme. Cognitive programme: 60 sets of weekly activities Mother enrichment programme: 30 bi-weekly group discussion sessions	Network of paraprofessional fieldworkers	Vocabulary, school report cards for Turkish and Mathematics and educational attainment.	a) Maternal literacy skills b) Mothers' self-esteem	Immediate post-programme: Positive effects on IQ scores, school grades, achievement test scores and general cognitive ability. Children with trained mothers had higher school adjustment ratings, more positive self-concept, and lower aggression. Trained mothers had higher educational aspirations for their children. 7-year follow up:

Appendix 8: Intervention studies targeting mothers with a view to enriching the home language and literacy environment

	Target age/ grade (sample size)	Country (Contextual-isation of intervention)	Intervention Content and duration	Implemented by	Child outcomes	Parent outcomes	Impact
							Children of mother enrichment group were more likely to be in school and have higher grades; mothers had higher expectations for children's further education. Fewer behaviour problems and more positive parent-child relationships were reported. Both mother training and educational care improved vocabulary. 19-year follow up High-quality early childhood enrichment positive effects carry over into young adulthood. Participants had higher school attainment, began working lives at a later age and had higher occupational status.
Rochdi, 2009↑	5 and 6 year olds; no formal instruction (45)	Morocco	Dialogic book reading with two sets of books. Set 1 books were designed to minimise linguistic	Researcher	Phonological awareness, expressive vocabulary; fast mapping; children's understanding of symbolic	Use of strategies during shared book reading sessions such as: use of WH questions about vocabulary, sounds, and print; modelling of	Storybook reading exposure positively impacted word learning capabilities and print awareness development. The effect of linguistic distance was significant on fast mapping but modest on vocabulary

	Target age/ grade (sample size)	Country (Contextual-isation of intervention)	Intervention Content and duration	Implemented by	Child outcomes	Parent outcomes	Impact
			distance in the diglossic Moroccan context, Set 2 books were standard books		representation ; book related concepts (cover page, last page, book title, print direction)	correct answers; expansion and repetition of the child's utterances; praise and encouragement	acquisition. Books that minimised linguistic distance significantly affected the quality of parent-child interaction but not phonological and print awareness development.
Rolla San Francisco et al., 2006→	Kinderg artners (210)	Costa Rica	Language and Literacy intervention	Volunteer high school students from private and public schools served as tutors. Details of service providers for the family intervention component not available	Vocabulary, Phonological Awareness, Print Concepts, Symbol Knowledge, & Reading Accuracy	n/a	Positive impact in combination with classroom and tutoring interventions on print concepts and letter identification. Active attendance in all three interventions positively impacted language composite

Appendix 9: Interventions for literacy and foundation learning in the early grades: evidence from individual studies

Intervention	Name, date, quality rating	Sample size	Method	Contexts
Dialogic reading	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, NGO, rural
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool, public and NGO
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Banerjee et al. (2007) (1st) →	good	RCT	India, G3 and G4
	Opel et al. (2009) ↑	small	RCT	Bangladesh, preschools, rural
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
	Cianca (2012) ↑	very small	Qual.	Ethiopia, G3, private urban 'budget schools'
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home based (enrichment of mother-child interaction)
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
Story telling	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Opel et al. (2009) ↑	small	RCT	Bangladesh, preschools, rural
	Borkum et al. (2012) ↓	good	RCT	India, public primary schools
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool, public and NGO

Intervention	Name, date, quality rating	Sample size	Method	Contexts
	Borzekowski and Henry (2011) ↑	small	RCT	Indonesia, preschool, rural
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, rural
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
	Nag-Arulmani et al. (2003) ↑	small	QED	India, English-medium schools, private, Grade 3
Shared book reading	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Opel et al. (2009) ↑	small	RCT	Bangladesh, preschools, rural
	Cianca (2012) ↑	Very small	Qual.	Ethiopia, privately owned urban 'budget' schools G3 (and G7)
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool, public and NGO
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
Phonological games	Nag-Arulmani et al. (2003) ↑	small	QED	India, English-medium schools, private, Grade 3
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
Systematic phonics	Dixon et al. (2011) ↑	moderate	QED	India, private unaided English-medium schools in urban slums
	Schagen and Shamsen (2007) ↑	moderate	QED	

Intervention	Name, date, quality rating	Sample size	Method	Contexts
Reciprocal teaching and buddy support	Cianca (2012) ↑	Very small	Qual.	Ethiopia, privately owned urban 'budget' schools Grades 3 and 7
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
Supporting emergent literacy	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home-based (enrichment of mother-child interaction)
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool, public and NGO
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, NGO, rural
Oral language inputs	Nag-Arulmani et al. (2003) ↑	small	QED	India, English-medium schools, private, Grade 3
	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool

Intervention	Name, date, quality rating	Sample size	Method	Contexts
	Moore et al. (2008)	small	Mixed	Bangladesh, preschool, NGO, rural
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Opel et al. (2009) ↑	small	RCT	Bangladesh, preschools, rural
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Aboud (2007) →	small	QED	Bangladesh, preschool
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home-based (enrichment of mother-child interaction)
Drawing on home experiences	Aboud (2007) →	small	HLE	Bangladesh, preschool
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home based (enrichment of mother-child interaction)
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
Literacy for communicative purposes	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
Demonstration of interactive processes that	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool

Intervention	Name, date, quality rating	Sample size	Method	Contexts
promote exploration and discovery by child	Bekman et al. (2011)→	moderate	QED	Turkey, preschool
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home based (enrichment of mother-child interaction)
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, NGO, rural
	Nag-Arulmani et al. (2003) ↑	small	QED	India, English-medium schools, private, Grade 3
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural
	Opel et al. (2009) ↑	small	RCT	Bangladesh, preschools, rural
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
Support with lesson plans	Bekman et al. (2011) →	moderate	QED	Turkey, preschool
	Borzekowski and Henry (2011) ↑	small	RCT	Tanzania, preschools, rural
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home-based (enrichment of mother-child interaction)
	Nag-Arulmani et al. (2003) ↑	small	QED	India, English speaking schools, G3
	Opel et al. (2012) ↑	small	RCT	Bangladesh, preschools, rural
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
Support with alternative ways to use teaching aids	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, NGO, rural
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool

Intervention	Name, date, quality rating	Sample size	Method	Contexts
	Borzekowski et al. (2010) ↑	small	RCT	Indonesia, preschool, rural
	Rolla San Francisco et al. (2006) →	small	RCT	Costa Rica, kindergarten, low-income neighbourhoods
	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
Demonstration of techniques to scaffold child's learning	Aboud and Akhter (2011) ↑	small	QED	Bangladesh, preschool, rural, low SES
	Mwaura et al. (2008) ↑	moderate	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Moore et al. (2008) ↑	small	Mixed	Bangladesh, preschool, NGO, rural
	Malmberg et al. (2011) ↑	small	QED	Kenya, Uganda, Zanzibar/ Tanzania, preschool
	Bekman et al. (2011) →	moderate	QED	Turkey, preschool
	Rochdi (2009) ↑	small	QED	Morocco, home based (with a parent)
	Kağitçibaşi et al. (2009) ↑	small	QED	Turkey, home-based (enrichment of mother-child interaction)
	Aboud (2006) →	moderate	QED	Bangladesh, preschool, NGO, rural

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