



United Nations
Educational, Scientific and
Cultural Organization

UNESCO
INSTITUTE
for
STATISTICS

TECHNICAL PAPER NO. 8



PRIMARY SCHOOL CURRICULA ON READING AND MATHEMATICS IN DEVELOPING COUNTRIES

PRIMARY SCHOOL CURRICULA ON READING AND MATHEMATICS IN DEVELOPING COUNTRIES



United Nations
Educational, Scientific and
Cultural Organization

UNESCO
INSTITUTE
for
STATISTICS

UNESCO

The constitution of the United Nations Educational, Scientific and Cultural Organization (UNESCO) was adopted by 20 countries at the London Conference in November 1945 and entered into effect on 4 November 1946. The Organization currently has 195 Member States and 8 Associate Members.

The main objective of UNESCO is to contribute to peace and security in the world by promoting collaboration among nations through education, science, culture and communication in order to foster universal respect for justice, the rule of law, and the human rights and fundamental freedoms that are affirmed for the peoples of the world, without distinction of race, sex, language or religion, by the Charter of the United Nations.

To fulfil its mandate, UNESCO performs five principal functions: 1) prospective studies on education, science, culture and communication for tomorrow's world; 2) the advancement, transfer and sharing of knowledge through research, training and teaching activities; 3) standard-setting actions for the preparation and adoption of internal instruments and statutory recommendations; 4) expertise through technical co-operation to Member States for their development policies and projects; and 5) the exchange of specialized information.

UNESCO is headquartered in Paris, France.

UNESCO Institute for Statistics

The UNESCO Institute for Statistics (UIS) is the statistical office of UNESCO and is the UN depository for global statistics in the fields of education, science and technology, culture and communication.

The UIS was established in 1999. It was created to improve UNESCO's statistical programme and to develop and deliver the timely, accurate and policy-relevant statistics needed in today's increasingly complex and rapidly changing social, political and economic environments.

The UIS is based in Montreal, Canada.

Published in 2012 by:

UNESCO Institute for Statistics
P.O. Box 6128, Succursale Centre-Ville
Montreal, Quebec H3C 3J7
Canada

Tel: (1 514) 343-6880
Fax: (1 514) 343-5740
Email: uis.publications@unesco.org
<http://www.uis.unesco.org>

ISBN 978-92-9189-109-2
Ref: UIS/TD/12-01 **REV**

©UNESCO-UIS 2012

The authors are responsible for the choice and presentation of the facts contained in this book and for the opinions expressed therein which are not necessarily those of UNESCO and do not commit the Organization. The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area, its authorities, or the delimitation of its frontiers or boundaries.

Acknowledgements

Based on a study commissioned by the International Working Group on Assessing and Improving Quality Learning, this report was prepared by Aaron Benavot (Department of Educational Administration and Policy Studies and the Institute for Global Education Policy Studies, University at Albany-State University of New York) for the UNESCO Institute for Statistics (UIS) in Montreal, Canada.

The UIS would also like to thank the following researchers and students for their expertise and efforts in support of this project: Gilbert Valverde, Samira Alayan, Lilia Verónica Toranzos, Yi-Jung Wu, Gloria Zambrano, Treisy Romero, Marcellus Taylor, Zakhar Berkovich, Newshaw Bahreyni, Polinda Keo, Fadi Kanaan, Laurence Padjip, Julliet Ochienghs, Prachayani Praphamontripong, Yaser Robles, Hue Do, Perveen Faisal, Muhammad Mubeen, Rostati Rostati, Chinthaka Jayawardena, Faisal Yaqoob, Zafar Aminov, Laura Manley and Dhanushki Samaranayake.

Table of contents

Acknowledgements	iii
Note on the International Curriculum and Textbook Archive (ICATA)	vi
1. Introduction	7
1.1 Study purpose and report structure	7
1.2 Background	8
1.2.1 The ‘Learning Counts’ initiative	10
1.2.2 Past research on intended reading and mathematics curriculum	11
1.3 Study activities	12
2. Compiling, coding and comparing intended reading and mathematics curricula	13
2.1 Construction of an international archive of curricular documents	13
2.2 How representative and diverse are the curriculum materials in the archive?	17
2.3 Do the physical characteristics of textbooks and curricular guides vary across countries? ...	20
2.4 Developing a coding scheme to compare curricular documents	21
2.5 Language and text translation issues	23
2.6 Document profiles resulting from the coding process	23
2.7 Quality assurance in coding procedures	24
2.8 Creating master tables of profiles and setting benchmarks for comparison	25
3. Results	27
3.1 Commonalities in the intended curricula of developing countries	28
3.2 Alignment between curricular intentions and textbooks	31
3.3 Establishing challenging standards in mathematics curricula	32
4. Discussion and concluding remarks	36
5. Suggestions for future activities	40
References	42
Appendix Tables 3–10	47
Annex 1	
Table A1.1 Year(s) of Publication of Curriculum Guidelines, by Country	66
Table A1.2 Year(s) of Publication of Textbooks, by Country	68
Annex 2	
Examples of ‘segments’ created from the table of contents of textbooks	70

List of figures and tables

Figure 1. Percentages of primary school enrolment in each region that are represented by curriculum materials in the international archive*	18
Figure 2. Weighted regional averages of GNP per capita (2007) for countries included in the archive as compared to the average of all developing countries in the region	18
Figure 3. The number of official curricular statements and guidelines in the international archive, by language.....	19
Figure 4. The number of textbooks and exercises in the international archive, by language	20
Figure 5. Alignment between the official curriculum and textbooks in mathematics, Grades 5 and 6	32
Figure 6. Alignment between the official curriculum and textbooks in reading, Grades 5 and 6	33
Figure 7. The emphasis placed on cognitively challenging performance standards in mathematics guidelines, by country and grade level	34
Figure 8. The emphasis placed on cognitively-challenging performance standards in mathematics textbooks, by country and grade level	35
Table 1. Overview of curricular materials obtained for each country/education system by document type and subject*.....	15
Table 2. Number of countries in each of the eight master tables	26
Table 3. Common contents and performance expectations in Grades 6, based on an analysis of curriculum statements and guidelines in mathematics	48
Table 4. Common content and performance expectations in Grades 5 and 6, based on an analysis of curriculum statements and guidelines in mathematics	50
Table 5. Common content and performance expectations in Grade 6, based on an analysis of textbooks in mathematics	53
Table 6. Common content and performance expectations in Grades 5 and 6, based on an analysis of textbooks in mathematics	56
Table 7. Common content and performance expectations in Grades 6, based on an analysis of curriculum statements and guidelines in reading	60
Table 8. Common content and performance expectations in Grades 5 and 6, based on an analysis of curriculum statements and guidelines in reading	61
Table 9. Common content and performance expectations in Grade 6, based on an analysis of textbooks in reading	62
Table 10. Common content and performance expectations in Grades 5 and 6, based on an analysis of textbook in reading	63

Note on the International Curriculum and Textbook Archive (ICATA)

This report is based on the compilation and coding of a large quantity of curriculum materials and textbooks, which almost entirely pertain to primary-level mathematics and reading from the developing world. All the materials and textbooks used in this report are part of the newly established International Curriculum and Textbook Archive (ICATA) located at the University at Albany-State University of New York. For further information and to access the Archive, go to: <http://www.albany.edu/eaps/icata/>

ICATA consists of two broad types of documents: 1) official curricular statements and guidelines and 2) textbooks (and some assessment instruments). Most documents in the first category are in digital format and can be obtained via ICATA or downloaded from official ministry websites. By contrast, most mathematics and reading textbooks in ICATA were obtained in printed format (hardcopy). As such, they are considered intellectual property, the copyrights of which are held by national ministries, private publishers and/or other entities. Access to these materials is only available through a visit to the Archive.

Scholars, policy analysts and students who are interested in visiting ICATA in Albany, New York are invited to contact Aaron Benavot (abenavot@albany.edu) or Gilbert Valverde (valverde@albany.edu).

Interested parties can also request, via email, any of the following items from the Archive:

- i) A comprehensive listing of the current holdings of ICATA for each country (in Excel format);
- ii) Copies of the coding frameworks (in Word format) and coded data used in the analysis (Excel and Word files); and
- iii) Copies of digital curriculum materials that are not under copyright (either in PDF or Word format).

Such requests should be sent to either Aaron Benavot or Gilbert Valverde.

In the near future, many of the digitized official curricular materials will also be available in UNESCO's International Bureau of Education (IBE) in Geneva.¹ The IBE catalogues a wide range of curricular materials and places them online in their electronic IBEDOCS website: <http://www.ibe.unesco.org/en/services/online-materials/ibedocs-en.html>. They will also include select items from ICATA.

¹ <http://www.ibe.unesco.org/en/services/external-links/curricular-resources.html>

1. Introduction

1.1 Study purpose and report structure

The overarching purpose of the study presented here is to compile, analyse and describe commonalities and differences in the intended primary curriculum in reading and mathematics across a diverse set of developing countries.² It is hoped that this study will contribute to on-going policy discussions on quality education among different national, regional and international stakeholders. The study results are meant to fill a gap in the current pool of knowledge concerning the intended contents and standards of the reading and mathematics curriculum in the developing world. By comparing curricular policies and documents among a diverse range of developing countries, it may be possible to devise new strategies to improve the skills and proficiencies that students are expected to acquire in mathematics and reading by the end of the primary cycle.

The introductory section of this report provides background information on how the notion of quality in education came to be viewed as an important element of the Education for All (EFA) agenda. Evidence of the increasing interest in providing quality education among governments, donors, international agencies and NGOs is also reviewed. In addition, an account is given on how and why the study discussed in this report came to be commissioned by the International Working Group (IWG) on Assessing and Improving Quality Learning, which was established at the UNESCO-sponsored Learning Counts seminar. Past research on the intended curriculum for mathematics and reading is briefly reviewed. The purpose of the study and the specific activities this project entails are also clearly stated.

Section 2 gives a detailed description of how the intended reading and mathematics curricula are compiled, coded and compared. The extent and diversity of data coverage within regions are reviewed. This section also documents how the research team dealt with coding issues due to the fact that documents collected for the study are produced in a multitude of different languages. Minimizing the inaccuracies that can arise from text translations entailed the use of language proficient coders, quality training to enhance inter-coder reliability and close monitoring for language-related 'problems'. Given the demanding nature of the coding process, several mechanisms were established to ensure the entry of high quality, reliable and valid data – including face-to-face training of coders, assessments of coding reliability and careful monitoring of the resultant document profiles created. Lastly, this section documents how document profiles and master tables of profiles were created and benchmarks set to establish commonalities among curricular documents in mathematics and in reading.

Section 3 reviews the results obtained from this study by providing answers to three key questions:

- 1) To what extent do diverse developing countries define similar content and performance expectations in reading and mathematics in the upper grades of primary education?
- 2) To what extent do the content domains of official curriculum statements in reading and mathematics align with those found in relevant textbooks?
- 3) In which countries are performance expectations in mathematics curricula more (or less) cognitively challenging?

² The category of 'developing countries' follows the UNESCO classification of countries from the following regions: Arab States; East Asia and the Pacific (excluding Japan, Australia and New Zealand); Latin America and the Caribbean (excluding Bermuda); South and West Asia; sub-Saharan Africa; as well as Cyprus, Israel, Mongolia and Turkey.

In essence, this section delves into how the findings address three separate issues – curricular commonalities across countries, within-country alignment between official guidelines and textbooks and country differences in the formulation of a challenging curriculum (for mathematics only).

Section 4 presents the main conclusions drawn from this study and how the results of the study can help in the development of alternative strategies to improve the quality of education in the primary cycle. Several observations and possible implications for improving learning assessments in the developing world are also discussed in this section.

Section 5 proposes future activities that can help build on the existing ICATA archive to improve, expand and make the archive more policy-relevant by addressing language-related questions.

1.2 Background

Having long sought to universalize access to primary education, national governments and international organizations began focusing on educational quality and learning outcomes during the World Conference on Education for All in Jomtien, Thailand (1990). During this meeting the international community committed itself to an ‘expanded vision’ of education that addresses the basic learning needs of all, including the provision of quality basic education and enhanced learning environments. The Jomtien Framework for Action (1990) specifically recommended that countries set national targets for an “...Improvement in learning achievement such that an agreed percentage of an appropriate age cohort (e.g. 80% of 14 year-olds) attains or surpasses a defined level of necessary learning achievement.”³ Background documents prepared for the Jomtien meeting compiled impressive evidence on factors affecting learning – for example, effective schools, curriculum implementation, the provision of learning materials, instructional time, teacher quality and child readiness to learn (see Lockheed and Verspoor 1990). Prior to the Jomtien meeting, the World Bank (1990: 54) published an influential policy statement on primary education, which, among other things, focused on learning outcomes. It recommended that “developing countries need to increase the number of children who acquire the skills specified in their nation’s curriculum and who successfully complete the primary cycle...[and thus] must emphasize students’ *learning* as the key policy objective.” Beyond declarations of policy intent, many countries took action. Beginning in the 1990s, country participation in large-scale national, regional and international assessments of learning outcomes took off (Benavot and Tanner 2007; Lockheed 2009; Kamens and Benavot 2011).

In 2000, when the international community reconvened in Dakar, Senegal, *quality education* had come to be viewed as a crucial component of the EFA agenda. National governments, NGOs and international agencies committed themselves to ‘Ensuring that by 2015 all children...have access to, and complete, free and compulsory primary education of *good quality*’ (EFA Goal 2). They also pledged to ‘*Improving all aspects of quality of education...so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills*’ (EFA Goal 6).

The Expanded Commentary on the Dakar Framework of Action (2000:15-17) further stressed that “...quality is at the heart of education, and what takes place in classrooms and other learning environments is fundamentally important to the future well-being of children, young people and adults.” Access to quality basic education was viewed as a fundamental right for all. “No one should be denied the opportunity to complete, good quality primary education because it is unaffordable... [I]mproving and sustaining the quality of basic education is equally important [to universalizing primary education] in ensuring effective learning outcomes...” Echoing earlier pronouncements at

3 See http://www.unesco.org/education/efa/ed_for_all/background/07Bpubl.shtml

Jomtien, the Dakar Framework asserted that quality education should “satisfy basic learning needs, and enrich the lives of learners...” Improvements in the quality of education require well-trained teachers and active learning techniques; adequate facilities and instructional materials; clearly defined, well-taught and accurately assessed curricular knowledge and skills; and a healthy, safe, gender-sensitive environment that makes full use of local language proficiencies.

The first decade of the 21st century witnessed a flurry of activities (not unlike the post-Jomtien period), during which government, agency, donor, and scholarly discussions of quality education increased substantially. Of note, for example:

- Several major international and ministerial-level meetings focused on educational quality (e.g. International Conference on Education, Geneva, 2004; Intergovernmental Meeting of the Regional Project in Education for Latin America and the Caribbean, Buenos Aires, 2007);
- An influential World Bank report recommended that countries and development partners emphasize learning outcomes as well as school access to improve the economic and social gains from current investment in primary education (World Bank Independent Evaluation Group, 2006);
- The Global Partnership in Education (formerly the EFA Fast Track Initiative) established a Quality of Learning Outcomes Task Team to develop recommendations for incorporating quality measures, such as the monitoring of learning outcomes, as additional criteria in the endorsement of EFA-GPE (formerly FTI) country plans (Moscow 2006, Cairo 2006 and Bonn 2007);
- Several UNESCO initiatives focused on educational quality: for example, teacher training and development in sub-Saharan Africa (TISSA) and learning processes (‘Enhanced learning: From access to success’) (UNESCO, 2007a);
- In 2006, international organizations and NGOs participated in a Global Action Week to highlight quality issues such as teacher supply and pre- and in-service teacher training; and
- Beginning in 2002, the EFA Global Monitoring Reports systematically examined measures of quality education such as teacher-pupil ratios, completion rates, teacher qualifications, instructional time and learning outcomes (e.g. UNESCO 2005; 2007b; 2008).

To be sure, despite renewed commitments to quality education and learning for all, and increased attention to these issues in international policy reports, real progress in key measures of quality lagged. More countries participated in one, sometimes several, learning assessments, but the evidence consistently indicated low absolute learning levels across many, if not most, developing countries as well as large disparities in learning outcomes between developed and developing countries (UNESCO 2008; UNESCO 2009). So while many governments may have incorporated quality-related aspects of the Jomtien and Dakar Frameworks in their official statements and national plans, measureable improvements in student acquisition of core subject knowledge and skills remained slow and uneven.

Large-scale assessments also underscored the pronounced differences in learning outcomes *within* countries. In most studies, learning disparities tended to fall along well-known fault lines – according to poverty, rural-urban residence, region, parental education, gender and disability as well as among different indigenous, ethnic, immigrant and language groups.⁴ These lingering achievement disparities are known to exacerbate socio-economic inequalities, reinforce inter-generational cycles of poverty and perpetuate the marginalization of disadvantaged groups.

⁴ Evidence of within-country inequalities is reported in Casassus et al. (2002), UNESCO-OREALC (2007), Martin et al (2004), Mullis et al. (2004), OECD (2004), OECD (2007), Torney-Purta et al. (2001), Mullis et al. (2007) and Ma (2008).

Thus, after more than two decades of initiatives, meetings and reports on quality education, three basic facts remain clear:

- The international community is aware of the global challenge and has committed itself to equalizing the provision of quality education and the improvement of learning outcomes, especially – but not only – among developing countries;
- The vast majority of countries in the world have embarked on concerted efforts to measure and assess learning outcomes in large-scale assessments; and
- Despite these commitments and efforts, millions of children in the developing world attend primary schools, many for several years, but fail to acquire a minimum toolkit of literacy and numeracy skills, and have limited mastery of core subject knowledge.

In short, finding ways to equalize the actual provision of quality education and improve learning outcomes constitutes a critical global challenge in education, especially for countries in the developing world.

1.2.1 The ‘Learning Counts’ initiative

To support country efforts to improve quality education for all, and within its broader EFA mandate, UNESCO convened a special seminar entitled *‘Learning counts: An international seminar on assessing and improving quality education for all’* in Paris on 28-30 October 2008. The seminar brought together over 30 experts in the areas of quality education and assessment, who represented major international agencies (World Bank, UNESCO, OECD), non-governmental organizations (IEA, CARE), bilateral aid agencies (GTZ) and educational research institutes in Russia, Kenya, Japan, France and South Africa. Many attending experts had been actively involved in designing and conducting learning assessments. The presentations and discussions focused on definitions of quality learning employed by different agencies; illustrations of learning measurement approaches in specific national, regional and international assessments; and the learning challenges faced by developing countries, in general, and educationally disadvantaged populations, in particular.

The Learning Counts seminar led to the establishment of the International Working Group (IWG) on Assessing and Improving Quality Learning, which was charged with:

- A. Exploring and discussing points of convergence among multiple approaches seeking to conceptualize, assess and improve quality education at the level of the learner, the school and the system. Specifically, the IWG was tasked with seeking consensus on a set of common core indicators of quality education in primary education for a broad range of countries and providing recommendations to be considered by relevant national and international stakeholders.
- B. Addressing the broader dimensions of quality by focusing on indicators of the conditions that enable learning, including the acquisition of knowledge, values and skills in the cognitive and affective domains, as well as actual teacher practices and classroom effectiveness.

During the first meeting of the IWG (5-6 March 2009), participants agreed that working towards quality primary education implies, among other things, the achievement of core learning proficiencies in literacy, numeracy and essential life skills by the end of the primary cycle. They noted the need to draw upon the International Standard Classification of Education (ISCED) to define the end of the primary education cycle, given that the structure of primary education varies across countries – and sometimes within countries.

The IWG also underscored the importance of examining intended curricular structures, guidelines and contents to determine the extent to which national (system) intentions or standards in reading and numeracy (i.e. at the end of the primary cycle or at the end of the segment of the cycle where reading and numeracy are explicitly taught) reflect a statement of minimum desired competencies. In principle, the Group thought that country initiatives in conjunction with this statement could be used to drive improvements in learning assessments and outcomes, and in the provision of quality education.

The IWG agreed that UNESCO should commission, as part of its background activities, a comprehensive review of the intended contents of reading and mathematics curricula in the latter grades of primary education in diverse developing countries. Such a study would seek to establish whether a core set of common contents and performance expectations in reading and mathematics can be identified, which could then serve as the basis for recommendations on the types of domains to measure minimal and/or desirable learning outcomes to be achieved in these subjects by the end of primary education. Assessing such core learning outcomes could play an important supplemental role in monitoring the overall performance and effectiveness of national primary school systems. The proposed study might also indicate which developing countries have established a more or less 'demanding' or cognitively challenging curriculum in literacy and numeracy.

1.2.2 Past research on intended reading and mathematics curriculum⁵

Previous cross-national studies on the official intended primary curriculum analysed national timetable data to describe broad curricular trends and patterns in some 80-100 countries (Meyer, Kamens and Benavot 1992; Benavot 2008). These studies report global and regional variation over time and place in the prevalence of, and the relative emphasis on, language and mathematics instruction (as well as other subject areas) in primary education. (Some studies collected this information by grade level). Other comparative research conducted during the initial TIMSS assessment (then known as the 'Third International Mathematics and Science Study') identified core mathematics and science contents and performance expectations common to primary and secondary schooling in almost 50 mainly industrialized nations. The identification of these shared contents and performance standards emerged from a detailed page-by-page content analysis of nationally representative samples of curriculum guidelines and textbooks (Schmidt et al. 1997; Valverde 2000; Valverde et al. 2002; Valverde and Schmidt 2000). The World Bank has also reported results from a content analysis of primary-level reading and mathematics textbooks in 15 developing countries (Lockheed and Verspoor 1990: 31-33).

Several international and regional learning assessments have collected subject- and grade-specific information on the intended curriculum of participating countries, usually in conjunction with the development of standardized test items. For example, recent assessments – e.g. Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS) – examined select information on mathematics, science and reading curricula for Grade 4 students in many high-income and some middle-income countries. Regional assessments have compiled select curricular information about:

- Grade 6 mathematics and reading curricula in 15 sub-Saharan African countries (see the Southern and Eastern African Consortium for Monitoring Educational Quality or SACMEQ);

5 While the official intended curriculum clearly structures what is actually taught in local schools and classrooms (the implemented curriculum), the gap between the intended and implemented curriculum can vary significantly within and across countries and even by subject area (see, for example, Resh and Benavot 2009). Many assume, based on limited *comparative* evidence, that the gap between the intended and implemented curriculum is considerably wider in the educational systems of the developing world.

- Grades 2 and 5 mathematics and language curricula for about 20 sub-Saharan African countries (see the *Programme d'analyse des systèmes éducatifs de la CONFEMEN* or PASEC); and
- Grades 3 and 6 mathematics and reading curricula for 16 Latin American countries (see the Latin American Laboratory for the Assessment of Quality in Education or LLECE).

In some of these assessment exercises, official documents and textbooks had been compared, mainly to identify common themes and develop test items. However, for various reasons (e.g. grade levels examined, the detail of coded contents) and given this study's particular focus, it was concluded that the knowledge base generated by these assessments would be of limited value in the effort to identify common elements in literacy and numeracy education across diverse developing countries.

1.3 Study activities

The specific activities to be carried out for this study, as specified in the Terms of Reference, included:

- Compiling materials on the intended reading and mathematics curriculum in the final grades of primary education from a significant number of developing countries (around 25-30) and ensuring adequate coverage by region and language – at least in English, Arabic, Spanish, Chinese and French;
- Developing and validating a coding scheme to systematically record, retrieve and compare the intended reading and mathematics curriculum from different primary education systems;
- Discussing an interim set of products emerging from the aforementioned project activities (including the coding scheme) with the IWG at meetings and electronically;
- Completing all compilation activities and cross-national analyses of the intended reading and mathematics curriculum and submitting a draft report for review by the IWG and UNESCO colleagues.
- Submitting a final report with the study's main findings.

2. Compiling, coding and comparing intended reading and mathematics curricula

2.1 Construction of an international archive of curricular documents

Competence in reading and mathematics is explicitly noted in the EFA goals and many argue, correctly, that student knowledge and skills in these core areas facilitate student progress in other curricular areas. Elements of reading and mathematics are often integrated in the teaching of other subject areas as a mechanism of reinforcement. Further, in many primary schools, the same teacher is responsible for instruction in all subject areas, making the reinforcement of the core skills of reading and mathematics more likely. With these considerations in mind, the project's first task was to build up an international collection of official, up-to-date curricular documents related to the teaching of reading and mathematics from a diverse array of developing countries. Ideally, this meant obtaining two types of government-sanctioned materials for each country:

- 1) Official documents outlining the intended curriculum in language/reading and mathematics for Grades 4-6; or alternatively, grade-specific programs of study (syllabi) or teacher guidelines prepared by a curriculum development unit in the ministry (or official government authority) that describe the topics and performance standards in reading and mathematics for students in Grades 4-6;
- 2) Officially sanctioned textbooks in reading/language and mathematics for Grades 4-6; or, in the absence of officially mandated textbooks, the most widely used and commercially produced textbooks in each subject area.⁶

Beginning in August 2009, the project team contacted representatives from international organizations (e.g. UNESCO's International Bureau of Education, the Georg Eckert Institute for International Textbook Research), experts in assessment and curriculum research and national ministry officials to determine if they possessed (or could obtain) the types of curriculum documents noted above either in a digital or hard-copy format. The team specifically requested current, as opposed to historical, curriculum documents. These inquiries resulted in the compilation of many curriculum materials. In subsequent months, additional documents were obtained through requests to international colleagues and through informal networks of graduate students at the University at Albany-SUNY.⁷ The project eventually assembled a large quantity of curricular materials from around the globe, the vast majority of which had been published since 2000 (see Annex 1). In October 2009, several experts and University of Albany graduate students began archiving the initial collection of textbooks and documents (digital ones were printed out) and finalized all relevant coding schemes and procedures.

The compilation of curriculum documents and textbooks continued apace and by June of 2011, the newly established International Curriculum and Textbook Archive (ICATA) had amassed over 580 curricular guidelines, textbooks and other related documents, representing different aspects of

6 In the vast majority of countries, a national textbook is produced for the public (and sometimes private) school system, either by the government itself or by a selected publishing house. In a small number of countries, schools choose from a set of commercial textbooks authorized by government authorities. In these latter cases the team sought to identify and obtain those textbooks that are used most broadly throughout the country.

7 The project also gathered information on three potentially useful textbook collections: 1) the G. Eckert Institute for International Textbook Research in Braunschweig, Germany, which concentrates on analysing social studies textbooks in history, geography and civics education; 2) a cross-national study of social science textbooks at Stanford University, which augmented materials initially identified at GEI (Meyer, Bromley and Ramirez 2010); and 3) an older collection at the Institute of Education (IoE) at the University of London consisting of various textbooks from developing countries. In the first two collections, there are almost no textbooks related to mathematics and language, since these subject areas have not been the focus of attention. Inquires with the IoE in London indicate that the Institute's textbook collection is significantly out-of-date and limited in terms of geographical coverage.

the intended contents of reading and mathematics in the upper primary grades for 60 developing countries and 7 autonomous education systems (*for a list of all curricular documents in ICATA, go to <http://www.albany.edu/eaps/icata/>*).⁸ (In addition the Archive contains another 63 documents that refer to more developed countries, or grades other than Grades 4-6, or in subjects other than mathematics and reading). In most cases, existing documents in ICATA provide an incomplete picture of the intended reading and mathematics curriculum for Grades 4-6 in each developing country. A future goal is to obtain supplemental materials to complete the curricular portrait of such countries. Nevertheless, to the best of our knowledge, ICATA is the largest archive of curricular materials from developing countries in the world.

Archived documents were initially classified into six categories: curriculum statements, guidelines, textbooks, exercise books, achievement tests and articles.⁹ It was subsequently determined that almost all documents could be easily divided into two general categories: 1) textbooks and exercise books; and 2) official curriculum statements and guidelines. Documents in the former category are usually developed by curriculum specialists and subject experts (many of whom work in academia or outside the educational system) and are used extensively by teachers for instructional purposes. They define the intended knowledge domains and topics to be taught in the classroom – along with the performance standards that students are expected to achieve as a result of classroom instruction. They also frequently constitute the basis for constructing test items for end-of-term or end-of-cycle learning assessments. For documents in the second category, a typical example is a national statement outlining the curricular policies and aims as well as the intended curriculum (program of studies) in language and/or mathematics for a specific primary grade. Documents in both categories, particularly the latter one, often mention other educational policies and intentions – for example, statements of broad educational goals, teaching methods, pedagogical philosophies and expected non-cognitive learning outcomes. Given the present project’s objectives, it was decided to keep the study focus exclusively on the analysis of subject contents and cognitive performance expectations.

In total, 578 curricular documents fell within the specific parameters of this study – in other words, they refer to official reading or mathematics statements, guidelines or textbooks; pertain to Grades 4, 5 or 6; and are used in the public primary schools of a developing country. Almost three-quarters (73%) of these documents are either textbooks or exercise books accompanying textbooks. About one-quarter (27%) constitute official curriculum statements or guidelines.¹⁰ The predominance of textbooks is not surprising since they are specifically designed to convey concrete school knowledge on a given subject at a particular grade level. Textbooks translate abstract curricular policies into concrete pedagogical activities that teachers and students enact in the classroom. As such, they are suggestive of policy enactment and have been characterized as the “potentially implemented” curriculum – a mediator between policy intention and policy implementation (Valverde et al. 2002).

8 Each line in the main ICATA file delineates the type, title and language of the document with the date and place of publication, and notes the curricular subject and grade level(s) to which it refers. Almost all compiled documents refer to a single country. The one exception is the case of the Eastern Caribbean, in which the official document provides information on curricular intentions in 5 small Caribbean states and 4 nearby territories, which share a common curriculum. Overall the international archive contains some curricular information for: 10 Arab States, 15 Latin American countries, 10 Caribbean countries (and 4 territories), 3 Central Asian countries, 11 Sub-Sahara African countries; 6 countries in South and West Asia and 10 countries in East Asia and the Pacific (see Table 1).

9 Definitions of these terms are as follows: *Curriculum* - an official government statement detailing, among other things, the topics to be taught in particular subjects and grade level(s) and performance expectations or goals; *Guideline* - an official document detailing curriculum-related instructions to curriculum developers, textbooks writers and/or teachers; *Textbook*: - a subject- and grade-specific text that details and structures classroom instruction and pupil learning; *Exercise* - a book, often accompanying a textbook, that includes specialized problems and exercises for students to complete so as to develop their skills and knowledge in a specific topic; *Test* - a written instrument used by teachers to evaluate student knowledge and skill performance; *Article* - a published report or study discussing or analysing the intended curriculum in a country or region.

10 In addition, we have obtained a very small number of tests (4) and published articles (2).

By contrast, official curricular statements/guidelines tend to be more comprehensive documents, and often contain policy information for multiple subjects and grade levels. They provide an overall rationale and blueprint of curricular policies to be implemented as well as act as policy directives that schools, principals and teachers are meant to put into practice. **Table 1** helps illustrate the more comprehensive character of official curriculum statements compared to textbooks. Although the archive includes a smaller number of curriculum statements/guidelines, these documents provide curricular information for 47 countries.¹¹ Textbooks, though greater in number, provide information for about the same number of countries – from 43 in mathematics to 45 in reading.¹² Scholars and policy analysts often raise questions as to the extent to which the curricular contents and expectations detailed in official statements and guidelines are in alignment with those found in authorized textbooks. In the results section (see *Section 3.2*), we examine the alignment issue for 12 countries in reading and 16 countries in mathematics.

Table 1. Overview of curricular materials obtained for each country/education system by document type and subject*

Region	Country/Education System	Official Curriculum Guideline or Syllabus		At Least One Textbook in ¹¹	
		Reading	Mathematics	Reading	Mathematics
Arab States	Egypt		✓	✓	✓
	Jordan	✓	✓	✓	✓
	Lebanon			✓	✓
	Libya			✓	✓
	Palestine			✓	✓
	Qatar		✓		
	South Sudan			✓	✓
	Syrian Arab Republic			✓	✓
	Tunisia	✓		✓	✓
	United Arab Emirates			✓	✓
Caribbean	Bahamas	✓	✓	✓	
	Dominican Republic	✓	✓	✓	✓
	Eastern Caribbean ¹¹	✓			
	Jamaica	✓	✓		
	Saint Lucia			✓	✓
	Trinidad and Tobago	✓	✓	✓	
East Asia and the Pacific	Cambodia	✓	✓	✓	✓
	China, all areas except Shanghai, Beijing & Hong Kong SAR	✓	✓	✓	✓

11 This number is higher for reading if the 5 small Caribbean countries covered in one official Eastern Caribbean document are included.

12 It is worth emphasizing that the number of documents compiled per country does not necessarily reveal the comprehensiveness of the information provided on the intended curriculum. For example, some countries have two textbooks for each grade (one per semester), or different textbooks for lessons and for exercises. Official curricular statements and guidelines can also be more or less comprehensive and detailed in the curricular information they contain.

Region	Country/Education System	Official Curriculum Guideline or Syllabus		At Least One Textbook in**	
		Reading	Mathematics	Reading	Mathematics
East Asia and the Pacific	China, Beijing			✓	✓
	China, Hong Kong SAR	✓	✓	✓	✓
	China, Shanghai			✓	✓
	China, Taiwan	✓	✓	✓	✓
	Indonesia			✓	✓
	Japan				✓
	Papua New Guinea		✓		
	Philippines	✓	✓	✓	✓
	Singapore	✓	✓	✓	
	Thailand	✓	✓	✓	✓
	Viet Nam	✓	✓	✓	✓
Latin America	Argentina	✓	✓	✓	✓
	Belize		✓		
	Brazil	✓	✓	✓	✓
	Chile	✓	✓	✓	✓
	Colombia	✓	✓	✓	✓
	Costa Rica	✓	✓	✓	✓
	Ecuador	✓	✓	✓	✓
	El Salvador	✓	✓		
	Guatemala	✓	✓	✓	✓
	Mexico	✓	✓	✓	✓
	Nicaragua	✓	✓		
	Panama	✓	✓		
	Paraguay	✓	✓	✓	✓
	Peru	✓	✓	✓	✓
Venezuela			✓	✓	
South and West Asia	Afghanistan				✓
	Bangladesh	✓	✓	✓	
	Bhutan	✓	✓		
	India	✓		✓	✓
	Iran			✓	✓
	Pakistan	✓	✓	✓	✓
	Sri Lanka	✓	✓	✓	✓
Sub-Saharan Africa	Angola	✓	✓		
	Benin	✓			
	Botswana	✓	✓	✓	✓
	Burkina Faso	✓	✓		
	Ghana	✓	✓	✓	✓

Region	Country/Education System	Official Curriculum Guideline or Syllabus		At Least One Textbook in**	
		Reading	Mathematics	Reading	Mathematics
Sub-Saharan Africa	Lesotho	✓	✓		
	Mauritius	✓	✓		
	Namibia	✓	✓		
	Senegal	✓	✓	✓	✓
	South Africa	✓	✓		
	Uganda	✓	✓	✓	✓
Central Asia	Armenia	✓	✓		
	Kyrgyzstan	✓	✓		
	Mongolia	✓	✓		
	Uzbekistan			✓	✓
TOTALS		47****	47	45	43

Notes: * For information on the exact grade level(s) or grade range of documents archived for each country, see <http://www.albany.edu/eaps/icata/>.

** The number of archived textbooks and exercise books per country ranges from less than 4 in Ecuador, Bangladesh, Chile and Indonesia, to more than 20 in Pakistan; China, Hong Kong SAR; and Thailand.

*** Refers to a regional document prepared by the Organisation of Eastern Caribbean States, Education Reform Unit for 5 countries (Antigua and Barbuda, Grenada, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines) and 4 territories (Anguilla, British Virgin Islands, Dominica and Montserrat).

**** Since this includes the Eastern Caribbean regional document, the actual number of countries for which curricular guidelines for reading exist is 47 (or 51 if territories are included).

2.2 How representative and diverse are the curriculum materials in the archive?

As Table 1 indicates, curricular information – albeit partial – is currently available for a significant number of developing countries in the following world regions: the Arab States, the Caribbean, Latin America, East Asia, and South and West Asia. The collection of official documents and textbooks for countries in Central Asia, sub-Saharan Africa (mainly francophone Africa) and the Pacific is less extensive.

To address questions on the coverage, representation and diversity of the international archive, the following graphs compare select aspects of the cases included in the archive with all developing countries. Comparisons are organized around the six UNESCO developing regions. **Figure 1**, for example, shows the percentage of primary enrolment in each region ‘covered’ by country curricular materials in the archive. This comparison indicates that, in enrolment terms, the archive’s coverage of the educational systems in East Asia (though not the Pacific), Latin America and the Caribbean, and South and West Asia is very strong, but is considerably less so for education systems in the Arab States and Central Asia and, least of all, for sub-Saharan Africa.

Figure 2 illustrates the extent to which developing countries in the archive are similar to all developing countries in each region in terms of average per capita income or gross national product (GNP). This comparison indicates that average income levels of cases in the archive are representative of all countries in Latin America, the Caribbean and South and West Asia. The archive tends to include a greater preponderance of lower-income developing countries in three regions (i.e. the Arab States, Central Asia and East Asia and the Pacific) and of higher-income countries in sub-Saharan Africa.

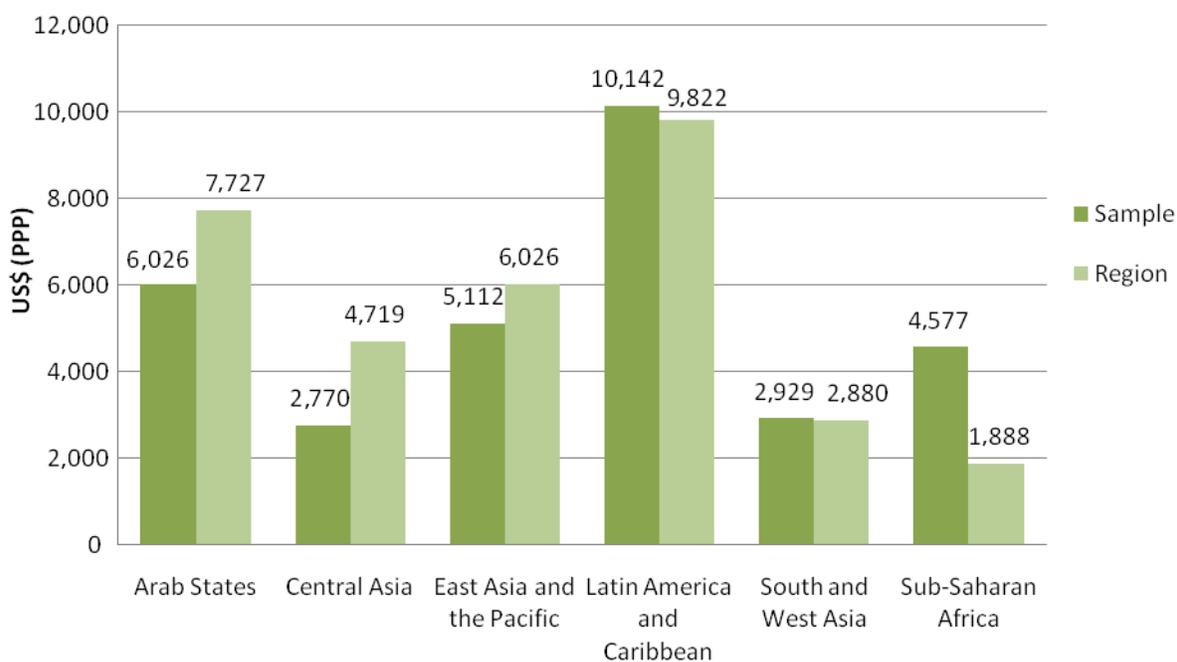
Figure 1. Percentages of primary school enrolment in each region that are represented by curriculum materials in the international archive*



Note: *Only primary enrolment in developing countries is included in the calculation of the regional rates of coverage.

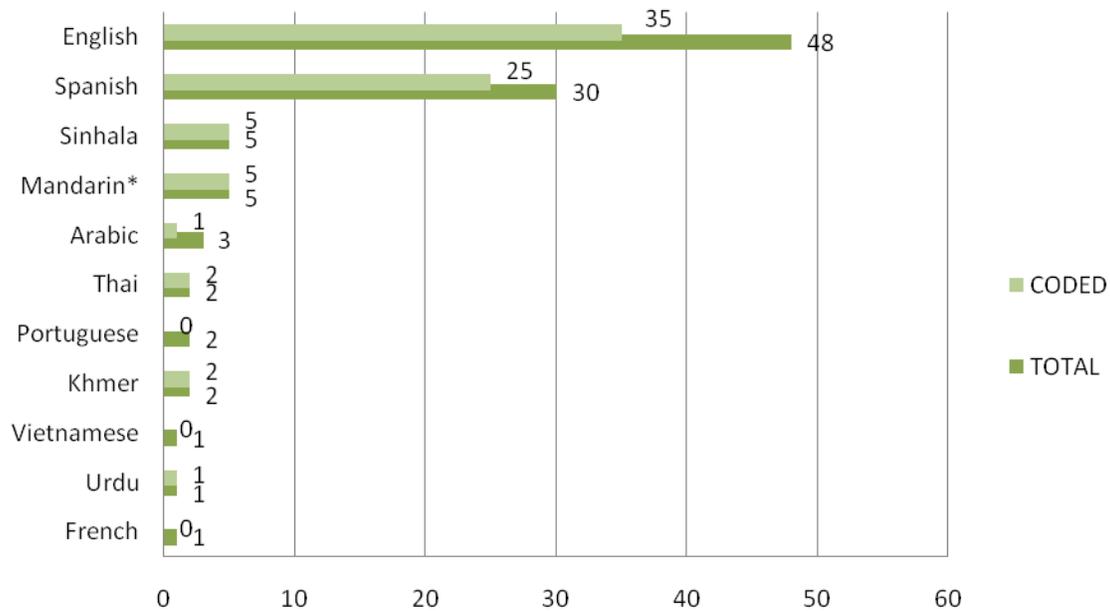
Source: Enrolment data are extracted from the annex tables of the EFA Global Monitoring Report (UNESCO, 2009).

Figure 2. Weighted regional averages of GNP per capita (2007) for countries included in the archive as compared to the average of all developing countries in the region



Sources: GNP and population data are extracted from the annex tables of the EFA Global Monitoring Report (UNESCO, 2009).

Figure 3. The number of official curricular statements and guidelines in the international archive, by language



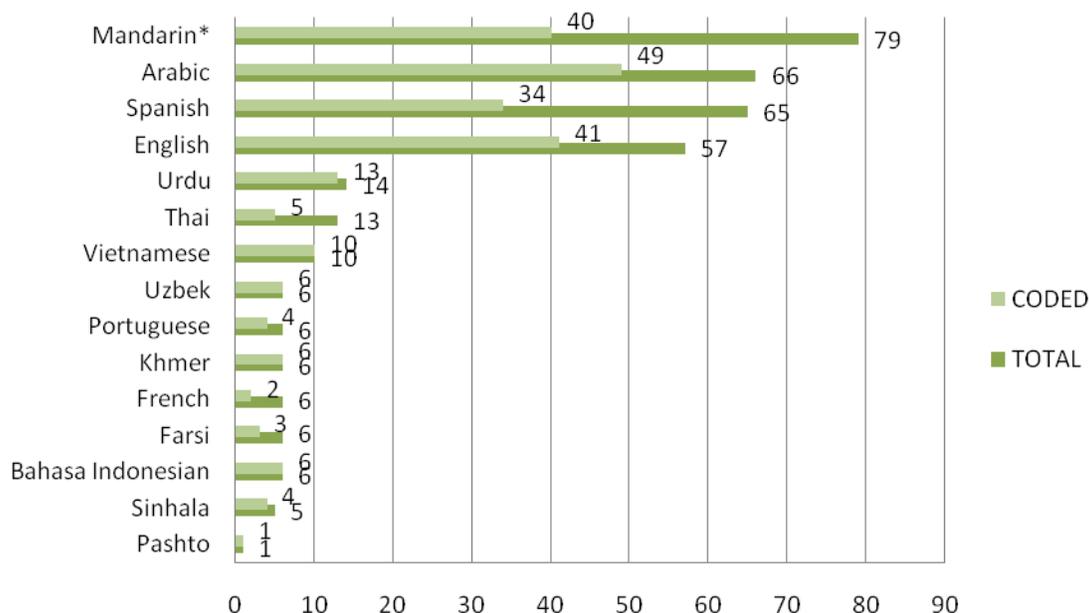
Note: * Mandarin Chinese includes both the traditional (Hong Kong, Taiwan) and simplified (Shanghai China and Singapore) forms.
Source: ICATA.

Ensuring language diversity in the archived curricular materials was an important goal in this study. All together, the project coded curriculum documents in 15 languages: Spanish, English, Arabic, Mandarin Chinese¹³, Urdu, Farsi, French, Portuguese, Thai, Bahasa Indonesia, Cambodian, Uzbek, Sinhala, Pashtu and Vietnamese. Language proficient coders were trained to code textbooks and curricular materials in each of these languages. The project was unable to locate a suitable coder in a timely fashion for only one language (Bangla). The distribution of languages found in the archived documents varies depending on document type (see **Figure 3** for official guidelines and **Figure 4** for textbooks). A comparison of the two frequency distributions indicates that English and Spanish are more commonly used in the preparation of official guidelines and curricular statements, whereas textbooks are much more likely to be written in a wider array of national or official languages.

Of note, while the curricular materials analysed in this cross-national study do not constitute a random or representative sample of all developing countries in the world, they do represent the official curricular intentions in some regions better than others. Specifically, the analysed cases provide a more representative picture of official policies and textbook contents in three regions: Latin America and the Caribbean, East Asia (though not the Pacific), and South and West Asia. More work will need to be done in the future to obtain materials from countries in the Arab States, sub-Saharan Africa and Central Asia in order to provide a more complete picture of curricular patterns in these regions.

¹³ Mandarin Chinese includes both traditional (Hong Kong, Taiwan) and simplified (Shanghai, China and Singapore) Mandarin.

Figure 4. The number of textbooks and exercises in the international archive, by language



Note: * Mandarin Chinese includes both the traditional (Hong Kong, Taiwan) and simplified (Shanghai, China and Singapore) forms.
Source: ICATA.

2.3 Do the physical characteristics of textbooks and curricular guides vary across countries?

In theory, countries produce or authorize textbooks that can vary significantly in terms of fonts, design and size; the use of colour; the inclusion of pictures, tables and figures; the presentation of the subject contents; and the use of end-of-chapter reviews. Curriculum developers and scholars have developed rather elaborate arguments rationalizing specific aspects of textbook design, all in the name of increased learning rates (Praphamontripong 2010). A cursory look through the extensive archives of social science textbooks at the G. Eckert Institute for International Textbook Research (Braunschweig, Germany) reveals considerable variety in the physical dimensions of textbooks.

Of the hundreds of mathematics and reading textbooks included in ICATA, a surprising number of similarities in their physical appearance are apparent. Book covers are generally made from heavy gauge paper, often covered with a transparent glossy material, and are about 27cm x 20cm in length and width. Almost all covers are illustrated in colour and are meant to appeal to, and attract, students. Thus, despite widespread cultural, language, economic and political differences, the vast majority of developing countries produce mathematics and reading textbooks that show minimal variation in external appearance.

Inside the textbooks, there is far less uniformity. The number of pages ranges from as few as 70 to as many as 300. While most of the printed text appears to be of an appropriate density, the extent to which colour and illustrations are used to enhance the text varies widely. For example, in a majority of textbooks about half of all the pages contain illustrations. By contrast, in a few books only about 10% of the pages are illustrated while in a few others there is an illustration on virtually

every page. The use of colour inside textbooks varies considerably: in about half of the textbooks, a diverse range of colours is used, whereas in about one-third of the books the text and illustrations are predominantly in black and white. The text of the latter books is typically printed on newsprint or low quality paper. They also appear to be published by government agencies, which have taken cost-reduction decisions to reduce the quality of the inputs.

Most of the mathematics and reading textbooks in the archive include a brief 'official' message (either from a Ministry official or the book's author/publisher) and a table of contents, which is immediately followed by the substantive content. Generally, the content is subdivided into units or themes or by some other pedagogically relevant criterion.

The design features of the curricular guides in ICATA are of less significance, given that many were digitized documents downloaded from the web sites of national ministries of education. Variation in the structure of these documents can be seen in the number of guidelines included as well as the level of detail provided. Some curricular guidelines include governmental statements elaborating on the meanings and purposes of primary schools or the overall system. In others such statements are muted or absent and the printed text focuses exclusively on the intended mathematics or reading topics and skills that students are expected to learn. Overall, the number of pages in this document type varies from a minimum of 20 to a maximum of 400 pages. Elements found in more elaborate guidelines include: vision statements of student learning, methodological and pedagogical strategies, the role of technology, and explanations of learning processes. With regards to content prescriptions, the majority of the documents list the subtopics along with the specific skills that students should acquire. Evaluation or assessment strategies as well as examples of specific learning activities are included in some documents. Finally curricular guidelines also differ as to whether they are focused on a single grade level (more common) or on multiple grades. In a few cases, the subject guidelines presented intended contents from pre-primary grades to the end of upper secondary education.

2.4 Developing a coding scheme to compare curricular documents

A central task of the present project was to develop and validate a coding scheme to systematically record and compare the intended reading and mathematics curriculum from different national primary systems. As previously noted, the bulk of a country's curricular intentions and policies can be captured in two document types – official guidelines/syllabi/statements and subject-specific textbooks. A 'valid' coding scheme for this study entailed a coding scheme that systematically recorded the *explicit* or *overt* contents of these two document types.

Textbooks and curricular materials can in fact reflect multiple social, cultural, political and educational ideas (e.g. political philosophies, pedagogical theories, normative notions of child development, gender roles, citizenship concepts, cultural values, etc.). Much of the studies in the social sciences highlight the implicit or *hidden* contents of textbooks and the curriculum. These studies have examined, for example, assumptions about gender, class, race, authority, morality, citizenship and what does (and does not) count as school 'knowledge' (Bowles and Gintis 1976; Dreeben 1968; Anyon 1980; Giroux and Purpel 1983; Lynch 1989). In the present study, this was less relevant since the focus is on the *overt* and intentional content of official guidelines and textbooks in the areas of reading/language or mathematics. With this in mind, a sufficiently detailed and comprehensive coding scheme was needed that would enable comparisons of content across a diverse range of documents and countries.

The best model for this coding scheme was found in the TIMSS and PIRLS assessments, which the team adopted and subsequently simplified.¹⁴ The elaborated coding frameworks for mathematics (TIMSS) and for reading (PIRLS) define highly detailed categories to capture two central dimensions of each curricular subject: 1) the *actual contents of what is being taught in each subject*; and 2) *the standards that students are expected to attain in each subject at a given grade level (or cycle)*. The first dimension captures subject-specific knowledge domains while the latter refers to the skills and competences, which students are expected to perform (attain) as a consequence of classroom instruction in the subject. These two dimensions – content and performance expectations – became the basis for comparisons across education systems and for determining cross-national commonalities.

One reason previous studies used an extremely detailed coding scheme is to provide relevant information not only to comparative education researchers and policy-makers but also to textbook authors and curriculum developers. However, given its focus on identifying *core* content commonalities across diverse developing countries, the current project required less detailed coding schemes. For this reason, slightly simplified versions of the original coding frameworks were developed for mathematics and reading (for copies of the coding frameworks, please access the ICATA archive at <http://www.albany.edu/eaps/international.shtml>).

The mathematics framework was divided into 10 general content topics that were divided into detailed sub-categories and even sub-sub-categories. The topics ranged from simple mathematical concepts (e.g. whole numbers, fractions and decimals) and operations to more complex topics such as geometry, proportionality and data representation. To achieve uniformity and simplify the coding process, the most detailed categories were excluded from the completed coding forms.

The performance expectations in the mathematics framework were organized in a similar way – from simple to more complex. Five basic performance expectations were considered: knowing, using routine procedures, investigating and problem solving, mathematical reasoning, and communicating. Each performance expectation was further subdivided into one or more specific competencies. The most detailed level included a list of highly specific activities or abilities that can be identified and classified in each textbook or document.

The reading framework initially detailed the types of written texts that students are expected to study, including their elements and purposes. This initial category elaborated over 60 types of written texts in different forms (e.g. story, fable, proverb, letter, essay, joke, personal diary, poem, form, report, editorial, play, novel, manual, news item, comics, catalogue, definition, sign, invitation and biography). The next dimension of the reading framework concentrated on specific elements of written texts (e.g. their structure and functions). In most categories, three or four levels of specificity were provided in order to achieve uniformity and be inclusive of all the topics contained in the reading documents and textbooks.

The performance expectations in the reading framework were divided by level of reading comprehension, beginning with the most basic form – identifying parts in the text. Overall, performance standards were divided into four categories: literal comprehension, inferential comprehension, value or evaluative comprehension, and meta-comprehension. Each of these categories included a brief description of the more specific proficiencies that students were expected to achieve.

14 For more information about these two international learning assessments, see <http://timss.bc.edu/>

2.5 Language and text translation issues

Language poses a singular challenge in this cross-national curriculum study given the variety of languages in which archived documents are written. The present study drew insights from similar challenges faced in the 1990s by the TIMSS Curriculum Analysis project – a large-scale international content analysis of official curricular documents (Schmidt et al. 1997; Survey of Mathematics and Science Opportunities 1992, 1992, 1993; Valverde et al. 2002).

In broad terms, a close adherence to the original language of the documents to be coded has distinct advantages – primarily in terms of authenticity, accuracy and minimizing sources of error. As this project sought to identify substantive commonalities among diverse reading and mathematics curricula, it was important to read (or carefully skim) the entire contents of each document or textbook. As such, translating and coding the ‘table of contents’ or summary exercises at the end of chapters would have biased the identification of commonalities. Indeed, aside from the considerable time and expense involved, translating documents into a common international language raises several methodological and substantive concerns: Is the translation accurate? Does it capture the intended meaning of the original text? Does the coder of the translated text understand the subtleties of the reading and mathematics activities described in the original text? Might coders tend to overestimate what is common across diverse texts when they are read or coded in a common international language?

Comparative education researchers have generated different responses to these issues (e.g. Goldstein 2004; Puchhammer 2007). Text translation, more often than not, creates new sources of inaccuracies and error. Thus, to avoid or minimize these and other translation-related pitfalls, it was decided to make every attempt possible not to stray from the original language. Consequently, the project expended a substantial amount of time identifying language proficient coders, assuring quality training to enhance inter-coder reliability and closely monitoring language ‘problems’ at weekly team meetings.

2.6 Document profiles resulting from the coding process¹⁵

Official curricular documents and textbooks are intricate and often lengthy. Special coding schema and procedures were developed to analyse their complex contents. To create a succinct, document-specific profile, coders began by dividing each document into a discrete number of ‘segments’ or ‘units’ for analysis – often, but not always, following the organization of topical contents within the document itself. Each segment served as a functional portion or section of the document, which could be coded using the mathematics or reading coding framework.

In practice, it was found that the content structures of textbooks, especially in mathematics, are relatively uniform. Units in textbooks often consist of similarly broad content topics, which the coders accordingly used to identify ‘segments’ (see Annex 2). Thus, in most cases, segments were defined according to each textbook’s content structure, provided in the table of contents. When the content structure differed significantly from this scheme, both with respect to textbooks and curricular guides, segments were defined by grouping similar content items.

¹⁵ The techniques briefly described here have been extensively reported in the literature on empirical studies of curricula (Cogan, Wang, and Schmidt 2001; Robitaille et al. 1993; Schmidt et al. 1996; Schmidt et al. 1997; Survey of Mathematics and Science Opportunities 1993, 1993; Valverde 2000, 2002, 2005; Valverde et al. 2002; Valverde and Schmidt 2000).

To maintain consistency across different document types in the same country and achieve acceptable levels of comparability across documents from different countries, the project research team initially had two or more coders delineate ‘segments’ of analysis in a sample of documents. Only when an agreement was reached on the rules to identify the segments in each document, did the actual coding process begin. This procedure often required informal translations of some documents so that several coders could consider materials written in languages in which they lacked proficiency.

The main coding procedure involved identifying the contents, performance expectations – and, in the case of reading, types of texts – found in, or relevant to, each functional ‘segment’ of a given curriculum statement or textbook. Coders read each segment and then assigned to each one a series of numerical codes from either the reading or mathematics framework. These codes became the main source of recorded data and the basis for characterizing and comparing official documents. For example, a 4th grade mathematics textbook might have 10 segments, most of which were assigned codes from the categories of whole numbers, operations, decimals and fractions. For a different grade level or in a country that had undergone curricular reforms in mathematics, the analysed textbook might have an equal number of segments, with some focusing on topics like proportionality, statistics and elementary geometry and thus receive other codes. As an example in reading, one national policy document may call on students to be exposed to a wide array of text types (e.g. brochures, itineraries, letters, biographies, poems, stories, electronic correspondence) while another might specify fewer text types, indicating, perhaps, that students are expected to work primarily with short stories and information-oriented articles.

Once the coding process for each document was completed, a set of specific content and performance expectation codes came to be associated with each one. Document profiles (strings of content and performance codes) were then aggregated within and across grade levels to describe the intended reading or mathematics curriculum of a country. In the next phase, analyses were performed to compare document profiles across and, sometimes, within countries. For example, to determine commonalities in the intended curriculum, aggregated national profiles were compared by subject and document type. A benchmark of 70% was set to determine whether a particular content item (or performance expectation) was held in “common” or not (see *Section 3.1*). In other words, the same number code needed to appear in at least 70% of the countries with documents of that type to be designated as a commonality. In other analyses, a comparison was done to determine whether the same codes were found in curricular guidelines and textbooks in the *same* country (see *Section 3.2*). In still further analyses, the proportion of segments in which particularly challenging mathematical codes were identified in documents was calculated and compared (see *Section 3.3*). Overall, all the analyses performed relied first and foremost on the creation of a single profile for a given curriculum statement or textbook at a given grade level.

2.7 Quality assurance in coding procedures

Given the large-scale of this multi-lingual project, quality assurance was particularly important. This study introduced several modifications to the aforementioned TIMSS coding methodology, resulting in procedures developed to balance measurement rigor with efficiency. An important difference between the TIMSS coding procedures and the present study was that all training and coding was carried out at a central location (i.e. the University at Albany-SUNY). The original TIMSS procedures used a ‘training of trainers’ formula, with a set of quality control procedures at the beginning and at the end of the data collection period, with coding occurring in multiple locations around the world.

In the current project, an initial one-week training and quality assurance session was convened, which brought together local graduate students and textbook and curriculum experts – all with

complementary languages proficiencies. Standard training materials developed for the TIMSS project and extended by the Educational Evaluation Research Consortium (Valverde 2003) for reading were used to familiarize coders with the full set of project procedures. These initial meetings used standardized presentations, training-to-criterion exercises and authentic curricular materials from a number of languages and countries across the world to build a common understanding of the document analysis procedures. When coders evidenced sufficient criterion concordance with the content experts on the team, they were assigned country documents in line with their language proficiencies and the main coding process began.

Given that the coding procedures were fairly demanding, several mechanisms were established to ensure the entry of high quality, reliable and valid data. These included the face-to-face training of new coders, an initial assessment of coding reliability and careful on-going monitoring of the resultant document profiles. In addition, the team held regular weekly meetings with the project's principal investigator, consultants and coding staff – during which time, group consultations were conducted to address specific coding issues as well as the assignment of new documents as they arrived. For documents in languages beyond the proficiencies of team members, new student-coders were identified and trained in the use of both subject frameworks. During an initial training phase, the trainees carried out a series of common exercises and began the coding exercise only after more experienced coding referees were satisfied that they had achieved a sufficient level of command of the procedures.

2.8 Creating master tables of profiles and setting benchmarks for comparison

As the project progressed, more and more curricular documents were coded, increasing the number and diversity of national curricular profiles in reading and mathematics. In an effort to set benchmarks, it made little sense to search for commonalities among *all* document profiles in the collection since, for example, the reading and mathematics profiles were based on entirely different coding frameworks. Less obvious but no less important was whether to combine analyses of different document types (i.e. official guidelines and textbooks). Given substantive differences in the purposes, scope, target audiences and uses of the two main document types, it was decided to conduct two separate searches for commonalities – among curricular guideline profiles and among textbook profiles.

Another issue related to the primary grade levels to be compared. Due to time constraints, the project only coded and compared documents from Grades 5 and 6. The question did arise on whether to compare the curricular intentions of Grade 5 and Grade 6 separately or in some combined fashion. In reality, there are disparities between curricula in different countries – some instruct students in, for example, geometry or proportionality in Grade 5 while others do so in Grade 6. In both cases, the topic is required knowledge by the end of the primary cycle. Thus, to allow valid inferences to be made for certain analyses, curricular information was *pooled* across both grade levels. With this in mind, separate analyses of commonalities were carried out on Grade 6 documents only – the modal final grade of primary education in most developing countries (UIS 2008:28); and then on the accumulated or pooled contents and performance expectations of documents for both Grade 5 and Grade 6.¹⁶ As expected, the resulting lists of commonalities in mathematics and reading tend to be longer when information is pooled for both Grades 5 and 6 as compared to Grade 6 only.

¹⁶ A country profile for Grades 5 and 6 means that the codes for Grade 5 *and* Grade 6 documents have been pooled, so that the resulting profile lists contents and performance standards that were found in Grade 5 and/or Grade 6. In addition, while the project has compiled quite a number of Grade 4 documents, most are not yet coded. It may be possible to include Grade 4 materials in a future analysis.

The aforementioned decisions resulted in a $2 \times 2 \times 2$ matrix of analysis by subject (mathematics and reading), document type (curriculum guideline and textbook) and grade level (Grade 6 only vs. Grades 5 and 6 combined) (see **Table 2**). In practice, all coded profiles were first categorized by subject and document type. When information existed for both Grades 5 and 6, a new pooled profile was created that combined information for the two grades.¹⁷

In the final analysis, the search for commonalities involved comparisons of country profiles within eight master tables – four in mathematics and four in reading. At this final stage, some questions did arise: What criterion or benchmark should be used to determine whether there are common specific contents within a master table? What percentage of countries in each master table needs to share a common content or performance code in order for the content area or performance expectation to be considered a commonality? Using past research as a guide (Schmidt et al. 1997), it was decided to employ a benchmark of 70%. In other words, a specific topic or performance expectation in reading or mathematics was deemed to be held *in common*, if it was present in at least 70% of the developing countries listed in a master table.

That said, if a master table contained too few country profiles (e.g. less than 10), then valid inferences concerning commonalities would be questionable. A lower limit was set of at least 15 (diverse) countries per master table in order to apply the 70% benchmark. Fortunately, this target was surpassed in every table. As Table 2 reports, the actual number of countries included in the eight master tables ranged from 23-33 (the average is 28.8).

Table 2. Number of countries in each of the eight master tables

Document types		Subject	
		Mathematics	Reading
Curriculum guidelines	Grade 6 (only)	27	23
	Grades 5 and 6	30	25
Textbooks	Grade 6 (only)	33	32
	Grades 5 and 6	31	30

¹⁷ The actual statistical profile of a country's intended curriculum (by subject and document type) is based on proportions (i.e. the number of segments in which a specific content category occurs). For the purpose of the present study, these proportions were transformed into dichotomous variables. In other words, the content category (or performance standard) was either present (or not) in the official document.

3. Results

The results reported in this section are organized around three research questions (and issues):

- 1) To what extent do diverse developing countries in the world define similar content and performance expectations in reading and mathematics in the upper grades of primary education? (the *commonalities* issue)
- 2) To what extent do the content domains of official curriculum statements in reading and mathematics align with those found in relevant textbooks? (the *alignment* issue)
- 3) In which countries are performance expectations in mathematics curricula more (or less) cognitively challenging?¹⁸ (the *challenging curriculum* issue)

Before presenting the detailed findings for each research question, several summary results should be noted. First, the analyses clearly point to considerable common ground among developing countries in the mathematics curriculum of the upper grades of primary education. Among the diverse array of mathematics textbooks analysed in this study, there is a surprisingly long list of common content and performance expectations. This is also the case, although to a lesser extent, when official curricular guidelines are compared. Furthermore, certain mathematics topics – for example, data representation and analysis, and proportionality – can be seen in many curricular documents, suggesting that select reforms in mathematics education have diffused into the policy environments of many developing countries.

Second, with respect to the reading curriculum, a more fragmented picture emerges. There is very little agreement among developing countries as to the types of written texts to be used when teaching literacy. Only a small number of text types (i.e. stories/tales, poems, plays, letters, historical accounts and biographies) are found in at least 70% of the upper grade reading textbooks analysed. There was also evidence of minimal agreement among countries concerning the intended content and structure of the upper primary reading curriculum. Divergent views are seen: 1) across grade levels within countries; 2) between official curricular statements and textbooks within countries; and 3) among the official documents of different developing countries. Performance standards represent the one realm of the reading curriculum where a clear set of commonalities emerge.

Third, in terms of alignment between curricular policy documents and textbooks, the *lack* of alignment is the norm. In most developing countries the percentage of shared contents is low and ranges between one-quarter to one-third of total contents. On average, this percentage tends to be relatively higher in mathematics than in reading. Overall, there is little indication that Grade 5 and 6 textbook authors closely follow the explicit official policy directives when devising textbook content in mathematics and reading.

Finally, the prevalence of cognitively challenging mathematics curriculum and textbooks varies considerably across countries both in Grade 5 and Grade 6. In some countries a high proportion of demanding standards are present in official guidelines and textbooks for both Grades 5 and 6. In others the proportion increases from Grade 5 to Grade 6. By contrast, some countries include relatively few cognitively challenging curriculum documents.

¹⁸ The same question in the area of reading may be examined in the future.

3.1 Commonalities in the intended curricula of developing countries

[Note: Please refer to the Tables in Appendix 1 (Tables 3-10) when reading this section.]

As a basis for identifying commonalities, eight tables (see the **Appendix**) have been constructed, which list only those detailed categories of contents and performance expectations in mathematics or reading that are shared by 70% of the developing countries for which data is available.¹⁹ In other words, if a content topic or performance expectation (or, in the case of reading, type of text) is not listed in one of the tables, this means that it was **not** present in at least 70% of the countries and thus not considered a common curricular element.

For mathematics, the key findings can be summarized as follows:

- As expected, the list of common mathematics contents and performance standards is longer when information for two grade levels (5 and 6) is pooled compared to the list when only one grade level (Grade 6) is used. This pattern obtains both with respect to curricular statements (Table 4 as compared to Table 3) as well as textbooks (Table 6 as compared to Table 5).
- In general, curricular guidelines in mathematics, which target teachers, school administrators, principals and inspectors, vary to a greater extent across countries in their detail and specificity than do mathematics textbooks. The list of commonalities in mathematics is shorter across official statements/guidelines than across textbooks (Table 3 vs. Table 5 or Table 4 vs. Table 6). Countries hold more divergent views of what should be included in official statements/guidelines. Thus, when official guidelines are compared, *fewer* curricular commonalities are seen and a less coherent picture of the intended mathematics curriculum emerges.
- Among the diverse array of mathematics textbooks analysed in this study, there is a surprisingly long list of common contents and performance expectations. This is apparent both in Table 5 (which only examines Grade 6 textbooks) and Table 6 (which pools information from textbooks used in either Grade 5 or Grade 6). Focusing on Table 6, more than 70% of the developing countries studied use textbooks that include instruction in whole numbers, fractions and decimals; number theory; measurement units and issues; one-, two- and three-dimensional geometry; proportionality concepts and problems; and data representation (excluding probability and statistics). Missing from this list are, for example, advanced mathematical topics in geometry; functions, relations and equations; elementary analysis; validation and structure; and probability and statistics. Overall, there are many commonalities in the content domains of Grades 5 and 6 mathematics – at least as reflected in the textbooks analysed.
- Both textbooks and official curricular guidelines also contain many shared performance expectations in mathematics. Most of these revolve around *routine and basic skills* in mathematical problem-solving and reasoning, and not in relation to the more cognitively demanding skills. For example, included among the commonalities are: representing mathematics expressions and recognizing equivalents; using measuring instruments; performing various kinds of counting, computing, graphing and measuring procedures; using more complex procedures (estimating and collecting data and classifying objects); and investigating (formulating mathematics statements to represent real world situations) and problem-solving. Missing from the list of commonalities are the more challenging standards: all types of mathematical reasoning as well as competences related to using mathematical vocabulary and notation; relating representations; and describing, discussing and critiquing

¹⁹ Only categories with numerical codes were coded and these constitute the basis for determining commonalities in each table. The sub-categories within these categories that lack such codes were used mainly to help coders understand the content of each numerical category.

written and verbal statements/expressions in mathematics. Also missing are two aspects of investigating and problem-solving: predicting and verifying.

- Among the list of shared mathematics topics, several elements are of particular interest. Whereas some topics have traditionally been part of primary mathematics curriculum for decades (e.g. whole numbers, fractions and basic geometry), other topics reflect contemporary reforms in mathematics curricula (e.g. topics in data representation and analysis). Topics representing recent reform trends in mathematics curricula that are currently found in a wide array of developing country textbooks and official guidelines include the following: collecting data; arraying them in simple tables and graphs; understanding simple measures of central tendency and dispersion; and sampling. Many of these topics have only recently entered pre-service teacher training programs worldwide (Mills 2007; Mullens et al. 1996; Philipp 2008; Wilburne and Napoli 2008). Thus, the findings suggest that the reform dynamic in mathematics education has impacted a broad spectrum of developing countries that have not yet been the subject of sustained empirical study. Many such countries are in agreement as to the merit of this type of challenging content in the upper grades of primary education.
- Proportionality is another reform-oriented topic that garners broad presence in upper grade textbooks but not in official intended curricular policies. Proportionality and the attendant topics in the area of fractions represent some of the most abstract and challenging subjects in primary school mathematics. They are considered vital to developing strong mathematical reasoning skills. Indeed, many experts agree that these topics represent the most cognitively demanding subjects in the primary school curriculum – often equally challenging for students and as it is for teachers. A number of authors observe that common and decimal fractions are the first serious exercises in the type of abstract mathematical reasoning that students will have to master if they wish to perform well in Algebra courses (Irwin and Irwin 2005; Jeong, Levine, and Huttenlocher 2007; Noddings 2009; Pagni 2004; Simon 2006; University 2006). The findings suggest that while textbook authors and editors agree on the importance of proportionality and related topics, formulators of official curriculum policy in these countries do not.
- Other findings further illustrate the divergent perspectives of the authors of official policy statements and those of mathematics textbooks. For example, in the area of performance expectations, curriculum statements in mathematics commonly call for the inclusion of cognitively more complex skills in such areas as estimating data or formulating and clarifying problems and situations (i.e. using mathematical expressions to represent real world problems). These competences, which are more demanding than routine procedural knowledge and algorithms, require more challenging learning opportunities (Blair, Knipe, and Gamson 2008; Buxkemper and Hartfiel 2003; Callingham and Watson 2004; de Castro 2008; van Oers and Poland 2007). Performance expectations of these types are more likely to be absent in official guidelines yet present in textbooks, raising concerns from a curriculum policy perspective.

In the area of reading, the main findings (Tables 7-10) can be summarized as follows:

- It is clear that developing countries hold divergent views on the contents of the upper grade primary reading curriculum. The findings point to much fewer commonalities across a wide range of texts, topics and content areas in the reading curriculum for Grades 5 and 6. This is especially true for official policy statements and guidelines and slightly less so for textbooks. The contrast of these findings with the intended mathematics curriculum is quite stark.
- Two patterns of results are similar across both subject areas. First, as in mathematics, the list of common contents and performance standards in reading is longer when information for two grade levels (5 and 6) is pooled rather than when just one grade level (Grade 6) is used. This pattern holds not only with respect to textbooks (Table 10 vs. Table 9) but also curricular

statements (Table 8 vs. Table 7). Second, the list of commonalities in reading is longer when examining textbooks as compared with official curriculum guidelines (Table 8 vs. Table 10 and Table 7 vs. Table 9). Once again, the specificity required of textbooks engenders greater common contents.

- Several findings concerning the contents of reading are especially noteworthy. First, textbook authors apparently draw on a wide array of text types to help students develop their proficiency skills in reading. From a list of over 60 types of written texts, only 6 were found in at least 70% of the Grade 5 and Grade 6 textbooks examined (i.e. stories/tales, poems, plays, letters, historical accounts and biographies). In Grade 6 textbooks, only the first two types of written texts (stories/tales and poems) are commonly found. Second, according to the analysed curricular guidelines, there is only one type of written text (poems) that 70% of the 25 developing countries viewed as necessary to be included in upper primary reading curriculum. Thus, policy analysts and ministry officials from the developing world hold few common views concerning the types of text that students are expected to use to acquire or strengthen their reading proficiency in an official language.²⁰
- Only one basic element of reading is common to both textbooks and curriculum guidelines – the inclusion of written text that is *informative*. It appears that official curricular guidelines in reading are rather general documents that lack specification and that authors of such guidelines and textbooks use different vantage points when defining the structure and purposes of written texts that primary students are expected to learn.
- Focusing solely on textbook contents for Grades 5 and 6, comparisons across countries indicate a slightly increased number of commonalities. For example, most textbooks include written texts that: 1) have plot types emphasizing narration, description, explanation and exposition; 2) include acts of speech involving a dialogue between two individuals; and 3) help students identify different plot elements (e.g. who does what to whom for what reasons, as well as identify the first, second or third person's viewpoint of the narrative). Most textbooks also provide explicit instructions to students on the different modes by which texts should be read – aloud, in silence and by scanning or skimming texts. All of the above elements of the intended reading curriculum were commonly found in over 70% of the Grade 5 and 6 textbooks studied, but are more rarely found in official statements and guidelines.
- With respect to reading skills/competences that students are expected to achieve in the latter grades of primary education, the cross-national evidence indicates considerably more commonalities. For example, more than 70% of textbooks and guidelines agree that students should: 1) identify, extract, find and remember explicit information in written text; 2) develop inferential skills to compare, deduce, generalize, apply, interpret, connect, summarize and paraphrase implicit elements in text; and 3) develop a range of evaluative judgments on the texts they read (e.g. the extent to which the texts are coherent/incoherent, precise/vague, complex/simple, valid, reliable, complete and plausible). These findings indicate that *despite pronounced cultural and linguistic differences, many developing countries share common ideas as to the desired reading standards to be attained by students at the end of the primary cycle*. These commonalities are known as literal comprehension, inferential comprehension and value or evaluative comprehension. A fourth element known as meta-comprehension – a term that encompasses, for example, the abilities to formulate and prove hypotheses, make predictions, continue reading, develop analogies and identify antecedents to the text – is only found to be common in literacy textbooks.

²⁰ The languages examined in the curricular guidelines for reading included, among others, Spanish, Urdu, English, Sinhalese, Mandarin Chinese, Thai and Cambodian.

3.2 Alignment between curricular intentions and textbooks

Over the years, the international assessment literature has emphasized a key distinction between the official, intended curriculum (what should be taught) and the implemented curriculum (what is actually taught). While comparative information on the former is fairly abundant, systematic evidence on the latter is considerably less. This stems, in part, from the fact that different conceptions and measurement strategies have been developed to capture the implemented curriculum (e.g. Rosier and Keeves 1991; Resh and Benavot 2009). The argument typically put forward is that student achievement levels will increase if the intended curriculum and the implemented curriculum are more closely aligned. This issue is especially salient in the developing world where many sources describe serious gaps or misalignments between the two (i.e. in terms of instructional time, textbook availability, etc.) (Abadzi 2007; GMR 2007b).

In this study, curricular guidelines and statements accurately represent the official intended curriculum in each subject. By contrast, as previously noted, textbooks provide an incomplete and inconsistent picture of the actual implemented curriculum. In settings where teachers organize their class lessons in close accordance with textbooks, then textbooks more closely approximate the actual implemented curriculum. However, this tendency varies greatly between classrooms, schools and regions, especially in developing countries. Therefore, it seems more fitting to refer to textbooks as instructional devices that mediate policy intentions and curricular implementation (Valverde et al. 2002).

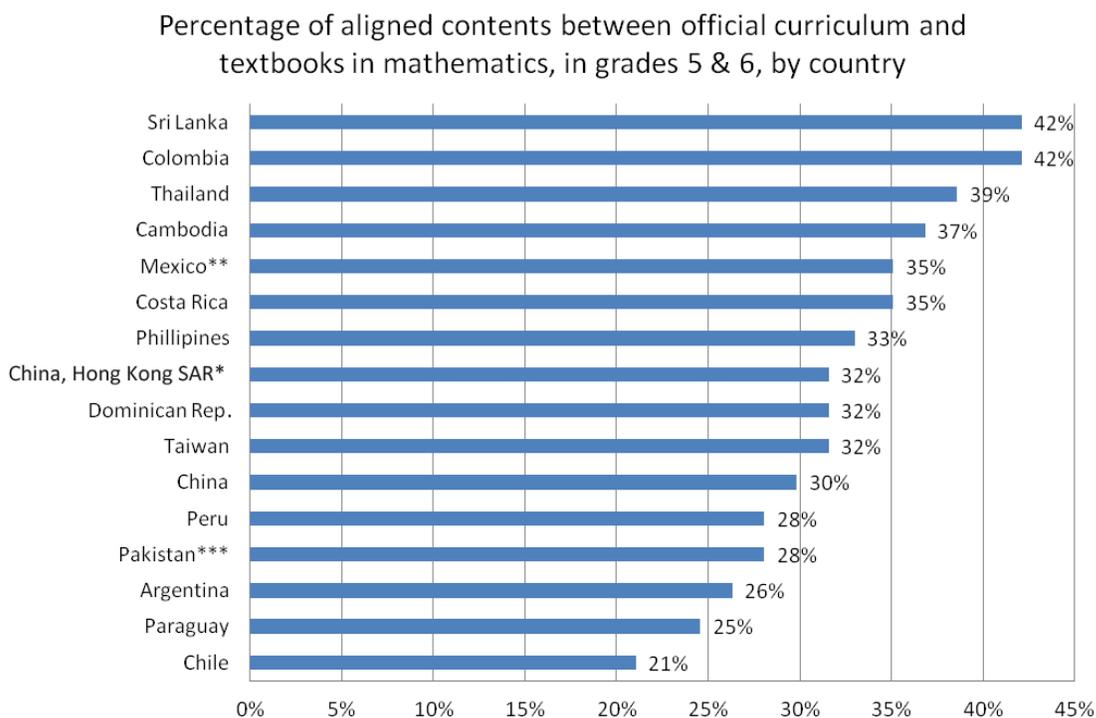
This study compiled analogous profiles of the contents of official guidelines and textbooks in mathematics and reading for a limited number of countries. By comparing the profiles of curricular guidelines to those of textbooks in the same country, the extent to which contents between the two documents are shared or are in alignment can be ascertained. In operational terms, when the same content codes appear in the profiles of both types of documents, a high level of alignment then characterizes the country or education system. In the analysis below, actual percentages are calculated by dividing the total number of shared codes found in both country documents (pooling information for Grades 5 and 6) by the total number of content codes found in the coding framework for each subject. The guideline-textbook alignment analysis in mathematics includes 16 countries or autonomous systems (see **Figure 5**). In the area of reading, this analysis includes 12 countries (see **Figure 6**).

Several interesting patterns can be discerned from Figures 6 and 7. First, estimated alignment levels (i.e. the percentage of shared contents between curricular policies and textbooks) are quite low. In mathematics, they range from a high of 42% in Sri Lanka and Colombia to a low of 21% in Chile and 25% in Paraguay. In reading, they range from 31% in Mexico to 7% in Thailand, Costa Rica and the Bahamas. In all of the developing countries studied, official curricular policy documents and textbooks share less than half of the same contents – in most cases the shared contents are between one-quarter to one-third. There is little indication that Grade 5 and 6 textbook authors closely follow the explicit official policy directives when devising textbook contents in mathematics and reading.

Second, the percentage of aligned content tends to be higher on average in mathematics than in reading. Not only are there more commonalities in mathematics than in reading across diverse developing countries (as previously shown), but there is also a closer alignment within countries between the intended and potentially implemented curriculum in mathematics.

Third, in some countries relatively higher alignment levels are found in both mathematics and reading (in Cambodia, Mexico, Philippines and, to a lesser extent, China, Hong Kong SAR; China, Taiwan; and the Dominican Republic). In other countries, the alignment levels vary by subject. For example, in Thailand a relatively high alignment in mathematics contrasts with a low one in reading – a similar

Figure 5. Alignment between the official curriculum and textbooks in mathematics, Grades 5 and 6



Notes: * The comparison is between the official curriculum in Grades 0-6 and the mathematics textbooks in Grades 5 and 6.

** The comparison is between the official curriculum in Grades 1-6 and the mathematics textbooks in Grades 5 and 6.

*** The comparison is only between the official curriculum and textbooks in Grades 4 and 5.

Source: ICATA.

pattern can be seen in Costa Rica. Additional evidence is needed before one can infer that tighter alignment between intended curricular policy and textbook content mainly reflects (centralized) government coordination and stakeholder communication or whether alignment patterns vary more systematically by school subject. Finally, in the case of Pakistan, alignment levels are below average in mathematics and above average in reading, but this is based on pooled information from textbooks used in different parts of the country (Sindh, Punjab and Khyber-PakhtoonKhwa).

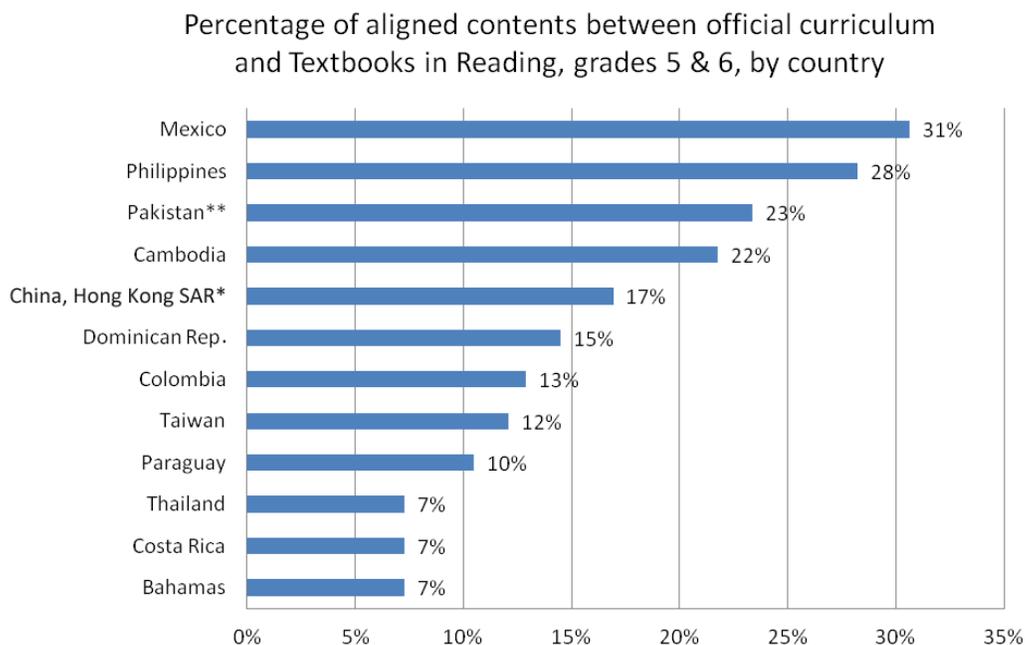
3.3 Establishing challenging standards in mathematics curricula

The drive to reform the school curriculum in the developing world often revolves around the types of knowledge, competences and values that students are expected to obtain upon completion of primary or basic education. Some countries focus on the mastery of basic skills in literacy and numeracy while in others, educational leaders want primary schools to expose students – especially in the upper grades – to more complex and challenging content in order to develop higher-order cognitive skills and related learning outcomes.

In this study, the coding of performance expectations in mathematics guidelines and textbooks enabled us to identify more or less cognitively challenging curricula in different countries.²¹ Drawing

²¹ In the future, it is hoped that similar analyses can be conducted in reading.

Figure 6. Alignment between the official curriculum and textbooks in reading, Grades 5 and 6



Notes: * The comparison is between the official curriculum in Grades 0-6 and the mathematics textbooks in Grades 5 and 6.

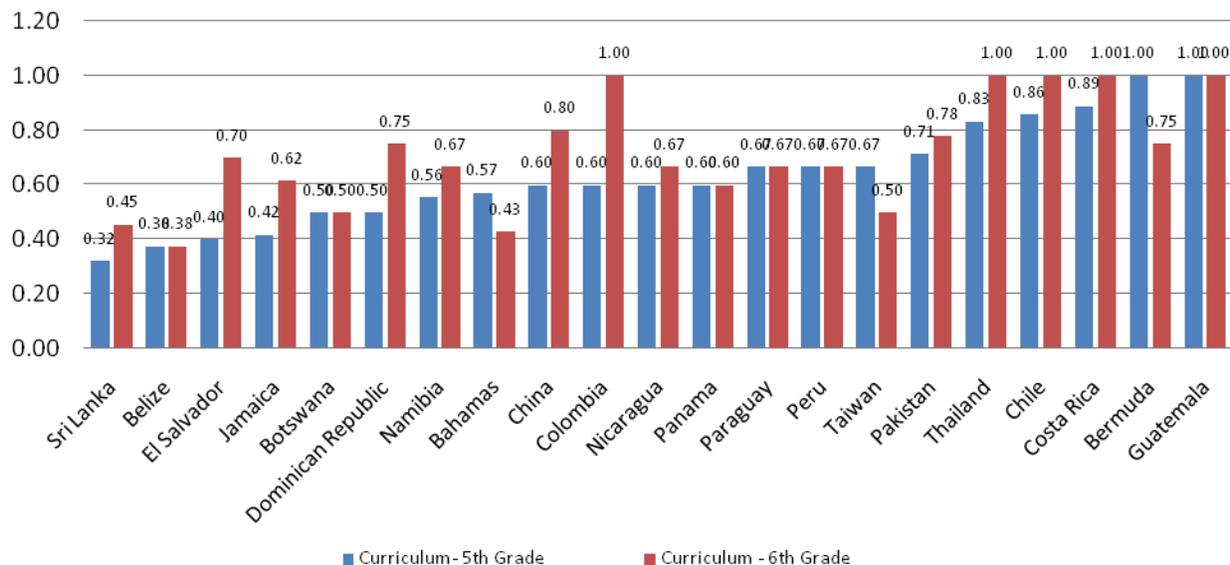
** The comparison is between the curriculum and textbooks used in Grades 4 and 5.

Source: ICATA.

on related research in the area of mathematics, all codes for performance expectations were re-classified to identify a subset of codes that denote the most cognitively demanding curricular standards (Schmidt et al. 1997; Brown, Schiller, and Roey 2010). Specifically, 8 out of 21 three-digit performance codes in mathematics were singled out as they entail higher-order cognitive reasoning and a broad set of problem solving strategies. Some codes denote that students should develop problem-solving strategies that go beyond simple procedures and be able to identify the steps or methods to finding a solution to a mathematical problem. Another code implies that students should consider alternative ways to solve problems using techniques taught in the classroom and develop algorithms to solve similar problems in other contexts. Two other skills that also represent more challenging skills are: identifying or stating an appropriate conjecture or drawing an appropriate conclusion in the discussion of a mathematical idea; and recognizing, selecting and presenting a counter example that demonstrates that a proposition is not true. In general, documents that contain a higher proportion of these cognitively challenging skills are indicative of policies that expect students to develop a deeper understanding of problem solving in mathematics, prove and justify their answers to mathematical problems, and see mathematical applications and connections outside the classroom.

To identify countries that emphasize cognitively-challenging standards, a scale was constructed from the eight performance expectations noted above. If one of these eight codes appeared in a document segment – even once – then it was counted as present (or one). Then for each document (either a

Figure 7. The emphasis placed on cognitively challenging performance standards in mathematics guidelines, by country and grade level



Source: ICATA.

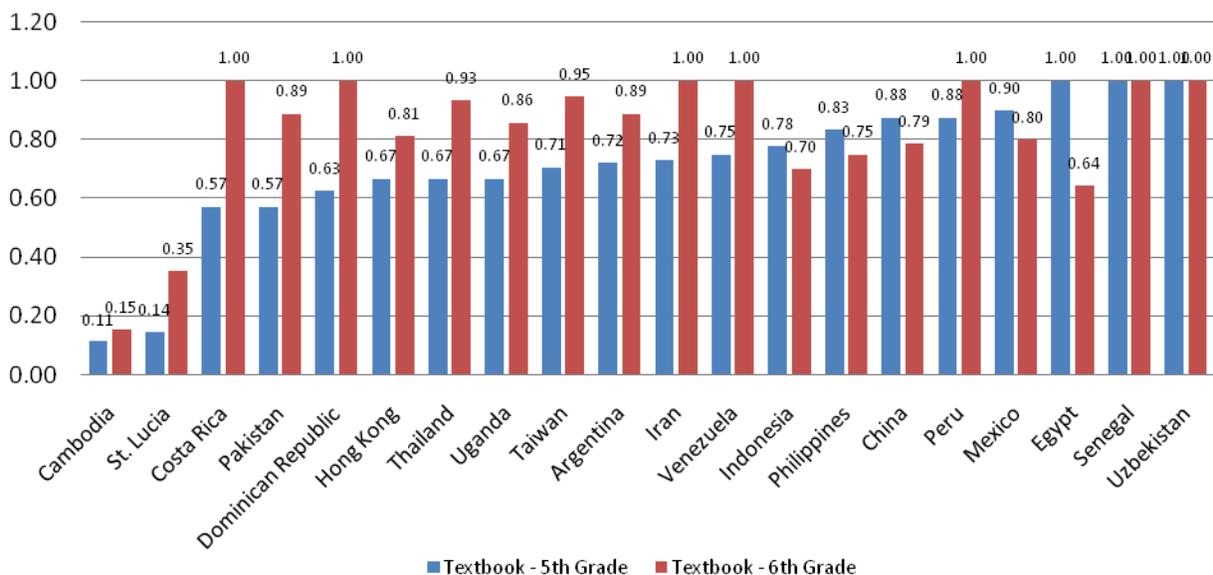
textbook or a curriculum guideline), the total number of such codes was summed and divided by the total number of segments in the document. The scale ranges from 0-1.0. A score of 1.0 denotes a country with cognitively challenging mathematics curricula (i.e. all segments in a coded document included at least one cognitively-demanding performance expectation). If a country stipulated more than one document in the intended curriculum (e.g. two semester-length mathematics textbooks), then the total number of performance expectations was divided by the total number of segments in all relevant documents. Analyses were conducted separately for Grade 5 and Grade 6 documents²² – in part to ascertain whether documents in the higher grade have increased proportions of cognitively demanding performance expectations. **Figure 7** examines cross-national differences based on an analysis of mathematics guidelines while **Figure 8** examines such differences based on textbooks.

Two clear patterns emerge from these analyses. First, the prevalence of cognitively-challenging mathematics curriculum and textbooks varies considerably across countries both in Grade 5 and Grade 6. In some countries (e.g. Guatemala, Bermuda, Costa Rica, Chile and Thailand), a high proportion of demanding performance expectations are present in official guidelines for both Grades 5 and 6. The same is true for an even larger number of countries in relation to their mathematics textbooks. By contrast, some countries include relatively few cognitively-challenging performance codes in their guidelines (e.g. Sri Lanka, Belize, Jamaica, Botswana, El Salvador) or in their textbooks (e.g. Cambodia, Saint Lucia).

Second, there is a tendency for performance standards to increase by grade level. This is more apparent among mathematics textbooks – in 13 out of 20 countries, the proportion of challenging expectations increased from Grade 5 to Grade 6 – and is also apparent in official guidelines where increases are found in 12 out of 21 countries. In some countries (e.g. El Salvador, Colombia in

²² In the cases of Saint Lucia and Pakistan grades 4 and 5 are compared instead of grades 5 and 6.

Figure 8. The emphasis placed on cognitively-challenging performance standards in mathematics textbooks, by country and grade level



Source: ICATA.

guidelines; Costa Rica and Pakistan in textbooks), the change between Grade 5 and Grade 6 is substantial. By contrast, in many other countries, the prevalence of cognitively-challenging standards changes little between Grades 5 and 6. In some countries, it actually declines – for example, in guidelines for the Bahamas, Taiwan and Bermuda; and in textbooks for Indonesia, Mexico and Egypt. Overall, the analyses indicate that the intended mathematics curriculum in many developing countries contains a large proportion of cognitively-challenging materials – and this tends to increase in higher grades.

In future analyses, this grade-related tendency can be examined more carefully once the coding of Grade 4 documents has progressed. It would also be germane to examine possible relationships between the structure of basic education and variations across countries and grade levels in the prevalence of cognitively-challenging standards in mathematics. For example, does the structuring of Grade 6 at the end of the primary cycle or at the beginning of the lower secondary cycle (or a third stage of basic education) influence the prevalence of cognitively-challenging expectations in mathematics curriculum?

Perhaps, more importantly, questions concerning the link with learning outcomes will need to be considered. Do countries that define more challenging performance expectations in either their official guidelines or their textbooks succeed in facilitating higher student achievements in mathematics? Or, do more demanding curricular policies place unnecessary or unwanted stress on teachers and school directors, many of whom are already struggling to inculcate basic competences in literacy and numeracy and seeking to minimize student repetition and maximize completion rates in primary education and higher transition rates to secondary education? These important questions deserve further scrutiny in future analyses as they cannot be addressed within the framework of the present study.

4. Discussion and concluding remarks

This study's primary purpose was to compile, analyse and describe commonalities and differences in the intended (upper grade) primary curriculum in reading and mathematics across a diverse set of developing countries. The study also addresses two related issues. First, the alignment issue, which explored the extent to which the contents of official curricular statements/guidelines and authorized textbooks are aligned with one another within a country. The second 'challenging curriculum' issue identified developing countries that have established relatively high or cognitively-demanding performance expectations in mathematics for students who complete 6 years of primary schooling.

This study and the results reported here are meant to fill a knowledge gap in current international policy discussions concerning the intended contents and standards of the reading and mathematics curriculum in the developing world. Comparing curricular policies and documents in reading and mathematics in a diverse range of developing countries provides a new evidentiary base from which to discuss alternative strategies to improve the skills and proficiencies that students should acquire by the end of the primary cycle. It is hoped that this study will contribute to on-going policy discussions on quality education among different national and international stakeholders. Several concluding observations, including possible implications for improving learning assessments in the developing world, are discussed in this section.

With respect to mathematics, the findings indicated that the developing countries in this study hold a fairly consensual and detailed view of what constitutes the mathematics curriculum in the upper grades of primary education – both in terms of content and performance standards. Long lists of commonalities in the intended mathematics curriculum were apparent in both document types – albeit more so among textbooks than official statements. These included core elements of primary level mathematics: whole numbers, fractions and decimals; number theory; measurement issues; one-, two- and three-dimensional geometry; proportionality concepts and problems; and data representation (though not probability and statistics). Also noteworthy was the presence of select reform-oriented mathematics topics – for example, data representation and analysis, and proportionality (in textbooks) – in the intended curriculum of many primary school systems in this study. This suggests an on-going trend: the growing diffusion and institutionalization of select curricular reforms in mathematics in the educational policy environments of many developing countries.

The analyses in this report also highlighted many common performance expectations in mathematics across countries and document types. These shared skill standards mainly revolved around routine and basic skills in mathematical problem solving and reasoning (e.g. representing mathematical expressions and recognizing equivalents; using measuring instruments; and performing various kinds of counting, computing, graphing and measuring procedures) but did not include more cognitively demanding mathematics skills.

With respect to the reading curriculum, a more fragmented picture emerged. Very few countries agreed on the types of written texts that should be used when teaching literacy. Only 6 of 60 different types of texts (i.e. stories/tales, poems, plays, letters, historical accounts and biographies) were found to be present in at least 70% of the upper grade reading textbooks analysed. There was also evidence of minimal agreement concerning the intended content and structure of the upper primary reading curriculum. Divergent views were uncovered: 1) across grade levels within countries; 2) between official curricular statements and textbooks within countries; and 3) among the official documents of different developing countries. In future analyses, the possible commonalities among countries sharing a common language (e.g. Spanish or Arabic) should be examined.

Performance standards represented the one notable realm of the reading curriculum where a clear set of commonalities emerged. Common performance expectations specifically pertained to literal, inferential and evaluative forms of comprehension. These findings suggest that the developing countries in this study share a fairly common notion as to the kinds of reading competences students should attain by the end of the primary cycle, but have different views of what constitutes the substance of the reading curriculum.

There are several possible explanations for these patterns. Mathematics is considered by many to be a scholarly field containing a relatively well-defined and integrated knowledge structure, in which different knowledge domains are tightly interwoven and sequenced. As such, one would expect greater specification – compared to other fields of knowledge – of which topics and contents are normally taught in primary school mathematics and in what sequence. Some scholars would contend that international networks are denser and expert exchanges more frequent in the field of school mathematics than in reading education. This would make it more likely that textbook authors and editors would develop a more definitive understanding of the contents of a ‘proper’ mathematics curriculum. These propositions help explain the greater consensus among developing countries regarding the content of primary level mathematics in contrast to reading.

Another explanation entails the more universal language of mathematics versus the more culturally-embedded process of acquiring literacy skills and competences in an official national language. Without denying the cultural meanings embedded in mathematics, in reading such elements are considerably more overt and explicit. Shared historical experiences and prominent cultural figures (or heroes) are likely to influence which authors and texts are chosen to be included in primary school curricula. Perhaps surprisingly, these choices also appear to impact the characters and plots deemed appropriate for primary students, the background information needed to comprehend and interpret the texts and so on. Few of the developing countries in this study shared a common notion of what elements should be included in the reading curriculum of the upper grades of primary education. The findings underscore the extent of divergent views concerning the basic content of reading (i.e. types of written texts, acts of speech, plot types, etc.). Nevertheless, developing countries do hold common views concerning the type of skills and proficiencies that they expect students to take away from their reading courses.

In another vein, and especially given the paucity of comparative evidence, it is extremely interesting to compare the intended reading and mathematics curriculum of more- and less-developed countries. To what extent, and in which areas, are there discernible differences in the intended mathematics and reading curriculum between these two groups of countries? How do the general or specific findings emerging from this study compare to those found in the analysis of more-developed countries? This is a fairly elaborate and challenging task, but several initial results can be noted. For example, the 2-dimensional geometry topics that appear in the set of the most prevalent mathematical contents in Grades 5 and 6 represent a difference from what a 1997 TIMSS study found (Schmidt et al. 1997). In the earlier study, 2-dimensional geometry topics were mostly incorporated in the curricular content at or before Grade 4, whereas 3-dimensional topics were rarely present in the intended curriculum – cross nationally – until about Grade 7 or 8. Some performance expectations, such as investigating and problem solving, were commonly present in Grade 4 TIMSS countries whereas they show up as ‘common’ in Grade 6 intended curricula in the present study. Such comparisons enable us to determine at which grade levels specific knowledge domains in mathematics (or in reading) are incorporated in the curriculum. In this study, for example, most of the developing countries have established a more challenging set of mathematics performance expectations in Grade 6 than in Grade 5. In the future, it would be important to determine whether this trend is also apparent when Grade 4 materials are analysed; and whether certain groups of countries – for example, defined by level of development, region or language – tend to establish a more rigorous curriculum compared to others.

Another pertinent (and related) question, especially in light of previous discussions among IWG members, is: What implications can be drawn from the present study to assess learning outcomes in reading and mathematics in developing countries? Some preliminary ideas about testing can be considered.

In the area of mathematics, developing countries vary in the extent to which they require the inculcation of relatively complex mathematical skills. Given the variability of cognitively more challenging performance expectations, it can be argued that there may be little demand for the development of capabilities in fielding complex performance assessments or other more expensive forms of standardized testing.

The large number of content domains prevalent in the upper grade mathematics curriculum of many developing countries suggests that the most common types of testing schemes (i.e. tests with small numbers of items) are probably inappropriate for making inferences regarding the achievement levels that students in a national educational system may obtain in these varied curriculum areas (Carson 2009; Chakwera, Khembo, and Sireci 2004; Ravela et al. 2001; Valverde 1998, 2002, 2003, 2005, 2009). Learning assessments should be able to tell different educational stakeholders what school children are able (and not able) to do in specific mathematical areas if in fact they are intended to serve as a basis for an informed, evidence-based dialogue on educational policy. The optimal number of items that can provide sufficient grounds for inferences about student achievement levels is thought to be about 8 to 15. Primary school students in Grades 5 and 6 can at best be asked to answer about 35-45 questions that are balanced in terms of cognitive complexity without running into problems with omitted and/or skipped questions. Thus, in order to field enough items to adequately measure different domains would require a matrix sampling procedure with rotated test forms – a demanding and uncommon practice in the domestic testing systems of most developing countries (ibid).

Participation in international assessments, such as TIMSS, could be reconsidered. With the kind of detailed curricular information this project has produced, many developing countries could potentially benefit from participation in large-scale international studies. The key is making sure to complement the typical cross-national analyses with studies specifically focused on the test subscales that are most aligned with their own national curricular contents and expectations. Indeed, when considering whether to participate in international testing programs, it is extremely important for developing countries to conduct sensible studies that focus on the curricular elements most closely aligned with their own curricular policies. This is not to disregard the importance of learning from other countries about students' abilities to master specific contents and skills in mathematics or reading that are not included in the current national curriculum. For example, in the early 1990s, the most optimistic estimates of the percentage of school children taking algebra in US middle schools was about 20% (Peak et al. 1996). However, evidence of the higher levels of achievements in algebra of the majority of school children in many TIMSS participating countries led to substantial changes in mathematics expectations for US middle school students – and today, the majority take algebra. Thus, participation in these studies also provides an important opportunity to challenge local notions of appropriate curricular expectations.

In the area of reading, the implications for learning assessments are far more complex. Few developing countries currently share a vision of which type of written texts are more or less important to utilize in the upper grades of primary education. Thus, it would be difficult to construct valid and feasible test instruments to assess different performance standards in reading comprehension – around which there is considerable agreement – using different types (or categories) of written texts. This also suggests that care must be exercised in inferences of the quality of reading comprehension

skills that are the results of schooling in developing countries, as derived from participation in large-scale international assessments (e.g. PIRLS, SERCE). Such assessments emphasize a limited number of text types, not always among the most commonly taught in the developing world. This would be the case, for example, of the PISA assessment which includes a number of continuous text types (e.g. argumentative and persuasive, injunctive, and expository) and also a set of non-continuous text types (e.g. charts, graphs, maps, etc.), which are not among the most common types of material covered in language curricula in the developing world. Inferences about outcomes in literacy must necessarily be cautious when students may not have had the opportunity to learn such material in class.

Future analyses will need to examine whether commonalities in types of texts are more prevalent in earlier primary grades (e.g. Grade 4), in particular among languages or groups of countries. The reading curriculum is intended to engender critical literacy skills among students, which have been shown to influence achievement in other areas of the school curriculum. With these concerns in mind, there is much value in expanding and enlarging the archive of curricular materials in reading, which this project has initiated. More in-depth analyses of the contents of primary school reading textbooks and official guidelines would help clarify how best and in which specific knowledge domains to assess reading-related learning outcomes among school children in the developing world.

5. Suggestions for future activities

This project has collected, compiled and coded curricular materials in reading and mathematics from a wide array of developing countries in the world. The newly established international curriculum archive, known as ICATA, fills a yawning gap in the existing knowledge base and should be of interest to many educational stakeholders (see: <http://www.albany.edu/eaps/icata/>). It also represents an important new resource to address timely and topical policy and scholarly issues concerning the primary school curriculum. Eventually, it is intended to contribute to the investigation of learning outcomes in the developing world.

The current international archive can potentially be improved in the future by:

- Completing the coding of the existing compilation of curriculum documents so that emergent findings could be validated and new lines of analysis can be pursued
- Selectively obtaining curriculum materials for certain countries so as to complete the curricular files of cases examined in this study.

The existing archive should be expanded to include:

- Mathematics and reading materials in the upper grades of primary education for countries in three 'under-represented' regions: francophone Africa, Central Asia and certain Arab states (e.g. Egypt, Morocco, southern and northern Sudan and in the Gulf).
- Curricular materials in the lower primary grades (especially in the area of reading), during which time acquiring proficiency in an official language represents a basic building block for academic achievement in other subject areas.
- Curricular materials to the lower secondary grades (Grades 7-9) to provide a more comprehensive picture of the knowledge base educational systems seek to provide during the basic education cycle.
- The intended curricular policies and textbooks in the areas of science and technology in the upper grades of primary education to identify commonalities and differences.

The existing archive can be made more policy relevant by addressing language-related questions, such as:

- To what extent does the language of instruction overlap with the language in which textbooks are provided? Which multi-lingual developing countries are presently providing textbooks in multiple languages, especially those spoken by members of indigenous groups as well as ethnic and linguistic minorities? Does the provision of language-specific curricular materials reduce repetition and increase completion rates in primary education?
- For languages used in multiple education systems (e.g. Arabic, Chinese, Spanish and English), are there clear associations between the specific content of and performance expectations in reading and mathematics and particular learning outcomes?

Of particular policy interest is the issue of the misalignment between curriculum guidelines and textbooks and national differences in establishing challenging or high-level curricular standards. Supplemental research should look at questions, such as:

- In which countries are intended curricular guidelines and textbook contents more or less closely aligned? Which national, regional and/or international factors account for the misalignment between intended policies and textbook realities? Why is the lack of curricular alignment more salient in reading than in mathematics, and which developing countries have established explicit policies to address this challenge, and with what effect?

- Which countries set forth the most cognitively-challenging standards in reading and mathematics, and for what intended purposes? To what extent do challenging standards serve to enhance learning levels for all or most students, or as selection mechanisms for identifying more (and less) academically able students?

In sum, additional collaborative efforts – institutional, financial and analytical – are needed in order to supplement the lessons learned from this study and add a new dynamic to on-going international efforts to improve the quality of learning for all primary school-age children.

References

- Abadzi, H. 2007. Absenteeism and beyond: Instructional time loss and consequences. Washington, DC, World Bank, Independent Evaluation Group Sector, Thematic and Global Evaluation Division. (Policy Research Working Paper, 4376.)
- Anyon, Jean. 1980. "Social class and the hidden curriculum of work," *Journal of Education* 162: 67-92.
- Benavot, Aaron. 2008. "The organization of school knowledge: Official curricula in global perspective." Pp. 55-92 in Julia Resnik (ed.) *The Production of Educational Knowledge in the Global Era*. Rotterdam: Sense Publishers.
- Benavot, Aaron and Erin Tanner. 2007. The growth of national learning assessments in the world, 1995-2006. Background paper for the Education for all global monitoring report 2008: Education for all by 2015: will we make it? Paris: UNESCO.
- Blair, Clancy, Hilary Knipe, and David Gamson. 2008. Is There a Role for Executive Functions in the Development of Mathematics Ability? *Mind, Brain, and Education* 2 (2):80-89.
- Bowles Samuel and Herbert Gintis. 1976. *Schooling in Capitalist America*. New York: Basic Books.
- Brown, Janis, Kathryn Schiller, Stephen Roey. 2010. The Breadth and Depth of High School Algebra I Courses: Examining differences in course content. Paper delivered at the annual meeting of the American Education Research Association. Denver, Colorado.
- Buxkemper, Andra C., and D. J. Hartfiel. 2003. Understanding. *International Journal of Mathematical Education in Science and Technology* 34 (6):801-812.
- Callingham, Rosemary, and Jane Watson. 2004. A Developmental Scale of Mental Computation with Part-Whole Numbers. *Mathematics Education Research Journal* 16 (2):69-86.
- Carson, Terrance R. 2009. Internationalizing Curriculum: Globalization and the Worldliness of Curriculum Studies. *Curriculum Inquiry* 39 (1):145-158.
- Casassus, J., S. Cusato, J. Froemel, and J. Palafox. 2002. First international comparative study of language, mathematics, and associated factors for students in the third and fourth years of primary school. Santiago, Chile: UNESCO.
- Chakwera, Elias, Dafter Khembo, and Stephen G. Sireci. 2004. High-Stakes Testing in the Warm Heart of Africa: The Challenges and Successes of the Malawi National Examinations Board. *Education Policy Analysis Archives* 12 (29)
- Cogan, Leland, S. Hsingchi, A. Wang and William H. Schmidt. 2001. Culturally Specific Patterns in the Conceptualization of the School Science Curriculum: Insights from TIMSS. *Studies in Science Education* 36:105-33.
- de Castro, Belinda V. 2008. Cognitive Models: The Missing Link to Learning Fraction Multiplication and Division. *Asia Pacific Education Review* 9 (2):101-112.
- Dreeben, Robert. 1968. *On What is Learned in School*. Reading, MA: Addison Wesley.
- Giroux, H. and David Purpel (eds.) 1983. *The Hidden Curriculum and Moral Education*. Berkeley, CA. McCutchan Publishing Company.
- Goldstein, Harvey. 2004. "International comparisons of student attainment: some issues arising from the PISA study." *Assessment in Education* 11:319-330)
- Irwin, Kathryn C., and R. John Irwin. 2005. Assessing Development in Numeracy of Students from Different Socio-Economic Areas: A Rasch Analysis of Three Fundamental Tasks. *Educational Studies in Mathematics* 58 (3):283-298.
- Jeong, Yoonkyung, Susan C. Levine, and Janellen Huttenlocher. 2007. The Development of Proportional Reasoning: Effect of Continuous versus Discrete Quantities. *Journal of Cognition and Development* 8 (2):237-256.

- Lynch, Kathleen. 1989. *The Hidden Curriculum: Reproduction in Education, An Appraisal*. London: Falmer Press.
- Ma, Xin. 2008. *A Global Perspective on Socioeconomic Differences in Learning Outcomes*. Background paper for EFA Global Monitoring Report 2009.
- Martin, M.O, Ina Mullis, E. Gonzalez and S. Chrostowski. 2004. *TIMSS 2003 International Science Report: Findings from IEA's Trends in Mathematics and Science Study at the Fourth and Eighth Grades*. Chestnut Hill, Mass: Boston College.
- Meyer, John W., David Kamens and Aaron Benavot. 1992. *School Knowledge for the Masses: World Models and National Primary Curricular Categories in the Twentieth Century*. Philadelphia: Falmer Press.
- Meyer, John W., Patricia Bromley, and Francisco O. Ramirez. 2010. "Human Rights in Social Science Textbooks: Cross-national Trends and Hierarchical Linear Models, 1975-2006." *Sociology of Education* 83 (2):111-134.
- Mills, Jamie D. 2007. *Teacher Perceptions and Attitudes about Teaching Statistics in P-12 Education*. *Educational Research Quarterly* 30 (4):15-33.
- Mullens, John E., Mary S. Leighton, Katrina G. Laguarda, and Eileen O'Brien. 1996. *Student Learning, Teaching Quality, and Professional Development: Theoretical Linkages, Current Measurement, and Recommendations for Future Data Collection*. Working Paper Series. Policy Studies Associates, Inc , Washington, DC.
- Mullis, Ina, M. Martin, E. Gonzalez and S. Chrostowski. 2004. *TIMSS 2003 International Mathematics Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades*. Chestnut Hill, Mass., TIMSS & PIRLS International Study Center, Boston College, Lynch School of Education.
- Mullis, I.V.S., Martin, M.O., Kennedy, A.M., and Foy, P. 2007. *PIRLS 2006 International Report: IEA's Progress In International Reading Literacy Study in Primary Schools in 40 Countries*. Chestnut Hill, MA: TIMSS and PIRLS International Study Center, Lynch School of Education, Boston College.
- Noddings, Nel. 2009. *What Can Teachers Learn from Research?* *Kappa Delta Pi Record* 46 (1):22-25.
- OECD. 2004. *Learning for Tomorrow's World: First Results from PISA 2003*. Paris, Organisation for Economic Co-operation and Development, Programme for International Student Assessment.
- . 2006. *Where Immigrants Succeed: A Comparative Review of Performance and Engagement in PISA 2003*. Paris, Organisation for Economic Co-operation and Development.
- . 2007. *PISA 2006 Science Competencies for Tomorrow's World*. Paris: OECD.
- Pagni, David. 2004. *Fractions and Decimals*. *Australian Mathematics Teacher* 60 (4):28-30.
- Peak, Lois, Nancy Caldwell, Eugene Owen, Harold Stevenson, Larry Suter, Mary Frase, William H. Schmidt, James Stigler, and Trevor Williams. 1996. *Pursuing Excellence: A Study of U.S. Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum, and Achievement in International Context*. Washington, DC: U.S. Department of Education. National Center for Education Statistics.
- Philipp, Randolph A. 2008. *Motivating Prospective Elementary School Teachers to Learn Mathematics by Focusing upon Children's Mathematical Thinking*. *Issues in Teacher Education* 17 (2):7-26.
- Praphamontriphong, Prachayani. 2010. *Textbook Formats and Visual Effects on Learning for Beginning Readers*. Desk review for the World Bank's Education for All Fast Track Initiative Project. Washington D.C.
- Puchhammer, M. 2007. "Language based item analysis - Problems in international comparisons." In *PISA according to PISA - Does PISA keep what it promises?* S. Hopmann, S., G. Brinek and M. Retzl (eds.) (LIT Verlag : Berlin and Vienna).
- Ravela, Pedro, Richard Wolfe, Gilbert Valverde, and Juan Manuel Esquivel. 2001. *Los Próximos Pasos: ¿Hacia Dónde y Cómo Avanzar en la Evaluación de Aprendizajes en América Latina?* Santiago, Chile: Grupo de Trabajo sobre Evaluación y Estándares - PREAL.

- Resh, Nura and Aaron Benavot. 2009, "Educational governance, school autonomy and curriculum implementation: Diversity and uniformity in knowledge offerings to Israeli pupils." *Journal of Curriculum Studies* 41 (1):67–92.
- Robitaille, David F., William H. Schmidt, Senta A. Raizen, Curtis C. McKnight, Edward D. Britton and Cynthia Nicol. 1993. *Curriculum Frameworks for Mathematics and Science*. Edited by D. F. Robitaille. Vol. 1, TIMSS Monograph Series. Vancouver, Canada: Pacific Educational Press.
- Rosier, M. and John Keeves (eds). 1991. *The IEA Study of Science I: Science Education and Curricula in Twenty-Three Countries*. Oxford: Pergamon Press.
- Schmidt, William H., Doris Jorde, Leland Cogan, Emilie Barrier, Ignacio Gonzalo, Urs Moser, Katsuhiko Shimizu, Toshio Sawada, Gilbert A. Valverde, Curtis C. McKnight, Richard S. Prawat, David E. Wiley, Senta A. Raizen, Edward D. Britton, and Richard G. Wolfe. 1996. *Characterizing Pedagogical Flow: An Investigation of Mathematics and Science Teaching in Six Countries*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Schmidt, William H., Curtis C. McKnight, Gilbert A. Valverde, Richard T. Houang and David E. Wiley. 1997. *Many Visions, Many Aims: A Cross-National Investigation of Curricular Intentions in School Mathematics*. Vol. 1. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Simon, Martin A. 2006. Key Developmental Understandings in Mathematics: A Direction for Investigating and Establishing Learning Goals. *Mathematical Thinking & Learning: An International Journal* 8 (4):359-371.
- Survey of Mathematics and Science Opportunities. 1992a. *Document Analysis Manual*. East Lansing, MI: SMSO.
- . 1992b. *Training Manual: Document Analysis, In-Depth Topic Trace Mapping Regional Training Meetings*. East Lansing, MI: SMSO.
- . 1993a. *TIMSS Curriculum Analysis: A Content Analytic Approach*. East Lansing, MI: SMSO.
- . 1993b. *TIMSS: Concepts, Measurements, and Analyses*. East Lansing, MI: SMSO.
- University, Michigan State. 2006. *Making the Grade: Fractions in Your Schools. Promoting Rigorous Outcomes in Mathematics and Science Education* 1:8.
- Torney-Purta, J., Lehmann, R., Oswald, H., & Schulz, W. 2001. *Citizenship and education in twenty-eight countries: Civic knowledge and engagement at age fourteen*. Delft, Netherlands: IEA
- UNESCO. 2000. *The Dakar Framework for Action: Education for All - Meeting our Collective Commitments*. World Education Forum, Dakar, UNESCO.
- . 2007a. *Enhancing Learning: From Access to Success. Report of the First Expert's Meeting: Defining Areas of Action*. Paris: 26 to 28 March, 2007. Paris: UNESCO.
- . 2007b. *Education for All by 2015: Will We Make It?* Oxford: Oxford University Press and Paris: UNESCO.
- . 2008. *Overcoming Inequality: Why Governance Matters*. Oxford: Oxford University Press and Paris: UNESCO.
- . 2009. *Reaching the Marginalized*. Oxford: Oxford University Press and Paris: UNESCO.
- UNESCO Institute for Statistics (UIS). 2008. *Global Education Digest 2008: Comparing Education Statistics Across the World*. Montreal: UIS.
- UNESCO-OREALC. 2007. *The State of Education in Latin America and the Caribbean: Guaranteeing Quality Education for All. A Regional Report, Reviewing and Assessing the Progress of Latin America and the Caribbean toward Education for All within the Framework of the Regional Education Project (EFA/PRELAC)*. Santiago, UNESCO Regional Bureau for Education in Latin America and the Caribbean.
- Valverde, Gilbert A. 1998. *Evaluation and Curriculum Standards in an Era of Educational Reforms*. In *Evaluation and Education Reform: Policy Options*, edited by B. Álvarez and M. Ruiz-Casares. Washington DC: U.S. Agency for International Development.

- . 2000. Strategic Themes in Curriculum Policy Documents: An Exploration of TIMSS Curriculum Analysis Data. *International Journal of Educational Policy Research and Practice*. 1 (2):133-152.
 - . 2002. Curriculum: International. In *The Encyclopedia of Education*, edited by J. W. Guthrie. New York: Macmillan Reference.
 - . 2003. La Política en Evaluación y Currículo Ante el Desafío de la Calidad. In *La Experiencia Internacional en Sistemas De Medición: Estudio De Casos*, edited by Comisión para el Desarrollo y Uso del Sistema de Medición de la Calidad de la Educación. Santiago, Chile: SIMCE.
 - . 2003. Monitoring and evaluation of educational opportunities and learning in USAID sponsored projects in the Dominican Republic - technical proposal in response to RFP: 517-03-017 and amendment 1, of 09.03.2003. Albany, New York.
 - . 2005. Curriculum Policy Seen Through High-Stakes Examinations: Mathematics and Biology in a Selection of School-Leaving Examinations From the Middle East and North Africa. *Peabody Journal of Education* 80 (1):29-55.
 - . 2009. Estándares y evaluación. In *Políticas Educativas y Cohesión Social en América Latina*, edited by S. Schwartzman and C. Cox. Santiago, Chile: Colección Cieplan.
- Valverde, Gilbert A., Leonard J. Bianchi, Richard T. Houang, William H. Schmidt, and Richard G. Wolfe. 2002. *According to the Book: Using TIMSS to investigate the translation from policy to pedagogy in the world of textbooks*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Valverde, Gilbert A., and William H. Schmidt. 2000. Greater Expectations: Learning from other nations in the quest for world-class standards in US school mathematics and science. *Journal of Curriculum Studies* 32 (5):651-687.
- van Oers, Bert, and Marielle Poland. 2007. Schematising Activities as a Means for Encouraging Young Children to Think Abstractly. *Mathematics Education Research Journal* 19 (2):10-22.
- Wilburne, Jane M., and Mary Napoli. 2008. *Connecting Mathematics and Literature: An Analysis of Pre-Service Elementary School Teachers' Changing Beliefs and Knowledge*. Issues in the Undergraduate Mathematics Preparation of School Teachers 2.
- World Bank Independent Evaluation Group. 2006. *From Schooling Access to Learning Outcomes: An Unfinished Agenda. An Evaluation of World Bank Support to Primary Education*. Washington, DC: World Bank.

Appendix

Tables 3–10

Note: Tables 3-10 are organized to highlight the ‘common’ content and performance expectations found in a range of textbooks or curricular statements in mathematics and reading at different grade levels. The term ‘common’ is used in a very particular way in these tables. It refers to the fact that those elements listed under ‘Content’ and ‘Performance Expectations’ (of all the possible elements that were identified in a country’s textbook or curricular statement) were held in common in 70% of the countries listed. So, for example, Table 5 lists those elements in mathematics that were found in at least 23 of the 33 national Grade 6 textbooks analysed. Other mathematics topics and performance standards that are NOT listed fell below the 70% benchmark and thus are not held in ‘common’.

Table 3. Common contents and performance expectations in Grades 6, based on an analysis of curriculum statements and guidelines in mathematics

Number of countries in the analysis = 27

List of countries: Argentina, Bahamas, Belize, Bermuda, Botswana, Cambodia, Chile, China, China (Taiwan), Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Jamaica, Lesotho, Namibia, Nicaragua, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Saint Lucia, Sri Lanka, Thailand.

1 Mathematics Content

1.1 Numbers

1.1.1 Whole Numbers

1.1.1.1 Meaning

- The uses of numbers
- Place value & numeration
- Ordering & comparing numbers

1.1.1.2 Operations

- Addition
- Subtraction
- Multiplication
- Division
- Mixed Operations

1.1.2 Fractions & Decimals

1.1.2.1 Common Fractions

- Meaning & representation of common fractions
- Computations with common fractions & mixed numbers

1.1.2.2 Decimal Fractions

- Meaning & representation of decimals
- Computations with decimals

1.1.2.4 Percentages

- Percent computations
- Various types of percent problems

1.2 Measurement

1.2.1 Measurement Units

- Concept of measure (including non-standard units)
- Standard units (including metric system)
- Use of appropriate instruments
- Common measures (length, area, volume, time, calendar, money, temp, mass, weight, angles)
- Quotients and products of units (km/h, m/s, etc.)
- Dimensional analysis

1.2.2 Computations & Properties of Length, Perimeter, Area & Volume

- Computations, formulas and properties of length and perimeter
- Computations, formulas and properties of area
- Computations, formulas and properties of surface area
- Computations, formulas and properties of volumes

1.3 Geometry: Position, Visualization & Shape

1.3.2 2-D Geometry: Basics

- Points, lines, segments, half-lines and rays
- Angles
- Parallelism and perpendicularity

1.3.3 2-D Geometry: Polygons & Circles

- Triangles and quadrilaterals: their classification and properties
- Pythagorean Theorem and its applications
- Other polygons and their properties
- Circles and their properties

1.3.4 3-D Geometry

- 3-dimensional shapes and surfaces and their properties
- Planes and lines in space
- Spatial perception and visualization
- Coordinate systems in three dimensions
- Equations of lines, planes and surfaces in space

1.7 Data Representation, Probability & Statistics

1.7.1 Data Representation & Analysis

- Collecting data from experiments and simple surveys
- Representing data
- Interpreting tables, charts, plots, graphs
- Kinds of scales (nominal, ordinal, interval, ratio)
- Measures of central tendency
- Measures of dispersion
- Sampling, randomness and bias related to data samples
- Prediction and inferences from data
- Fitting lines and curves to data
- Correlations and other measures of relations
- Use and misuse of statistics

2 Performance Expectations

2.1 Knowing

2.1.1 Representing

- Select an appropriate representation
- Construct an appropriate informal representation for the subject (e.g. a sketch)
- Construct a formal representation governed by strict construction procedures (e.g. geometric construction)

2.1.3 Recalling Mathematical Objects and Properties

- Recalling mathematical objects and properties
- Recognizing mathematical objects and properties

2.2 Using Routine Procedures

2.2.2 Performing Routine Procedures

2.2.2.2 Computing

- Identify an appropriate single computational operation
- Identify an appropriate single computational method
- Predict the effect of a computation operation or method
- Perform a single computational operation (e.g. multiply decimal fractions or matrices)
- Compute without aid of a computational device using an ad hoc procedure
- Compute without aid of a computational device using a known algorithm or procedure
- Compute by use of a formula (e.g. compute a mean)
- Compute using results of a simulation (e.g. find a probability on the basis of simulated experiment)
- Compute using inference and properties of a model (e.g. find a probability using a simple probability model)

2.2.2.5 Measuring

- Measure a physical object, iconic (pictorial) image or geometric figure in either standard or non-standard units
- Identify a measurable attribute of a physical object or image
- Select an appropriate unit for a given measurement
- Select an appropriate tool for a given measurement
- Select an appropriate degree of accuracy for a measurement in a given situation and task

2.3 Investigating and Problem Solving

2.3.3 Solving

- Solve a problem requiring a single step or operation
- Solve a problem requiring more than one step or operation
- Solve by transforming a representation (e.g. solve equations by algebraic manipulations to yield a sequence of equivalent equations)
- Solve the same problem in alternative ways using differing representations

Table 4. Common content and performance expectations in Grades 5 and 6, based on an analysis of curriculum statements and guidelines in mathematics

Number of countries in the analysis = 30

List of countries: Argentina; Bahamas; Belize; Bermuda; Botswana; Cambodia; Chile; China; China, Special Administrative Region of Hong Kong; China (Taiwan); Colombia; Costa Rica; Dominican Republic; El Salvador; Guatemala; Jamaica; Lesotho; Mauritius; Mexico; Namibia; Nicaragua; Pakistan; Panama; Paraguay; Peru; Philippines; Saint Lucia; South Africa; Sri Lanka; Thailand.

1 Mathematics Content

1.1 Numbers

1.1.1 Whole Numbers

1.1.1.1 Meaning

- The uses of numbers
- Place value & numeration
- Ordering & comparing numbers

1.1.1.2 Operations

- Addition
- Subtraction
- Multiplication
- Division
- Mixed operations

1.1.1.3 Properties of Operations

- Associative properties
- Commutative properties/identity properties
- Distributive properties
- Other number properties

1.1.2 Fractions & Decimals

1.1.2.1 Common Fractions

- Meaning & representation of common fractions
- Computations with common fractions & mixed numbers

1.1.2.2 Decimal Fractions

- Meaning & representation of decimals
- Computations with decimals

1.2 Measurement

1.2.1 Measurement Units

- Concept of measure (including non-standard units)
- Standard units (including metric system)
- Use of appropriate instruments
- Common measures (length, area, volume, time, calendar, money, temp, mass, weight, angles)
- Quotients and products of units (km/h, m/s, etc.)
- Dimensional analysis

1.2.2 Computations & Properties of Length, Perimeter, Area & Volume

- Computations, formulas and properties of length and perimeter
- Computations, formulas and properties of area
- Computations, formulas and properties of surface area
- Computations, formulas and properties of volumes

1.3 Geometry: Position, Visualization & Shape

1.3.2 2-D Geometry: Basics

- Points, lines, segments, half-lines and rays
- Angles
- Parallelism and perpendicularity

1.3.3 2-D Geometry: Polygons & Circles

- Triangles and quadrilaterals: their classification and properties

- Pythagorean Theorem and its applications
- Other polygons and their properties
- Circles and their properties

1.3.4 3-D Geometry

- 3-dimensional shapes and surfaces and their properties
- Planes and lines in space
- Spatial perception and visualization
- Coordinate systems in three dimensions
- Equations of lines, planes and surfaces in space

1.7 Data Representation, Probability, & Statistics

1.7.1 Data Representation & Analysis

- Collecting data from experiments and simple surveys
- Representing data
- Interpreting tables, charts, plots, graphs
- Kinds of scales (nominal, ordinal, interval, ratio)
- Measures of central tendency
- Measures of dispersion
- Sampling, randomness and bias related to data samples
- Prediction and inferences from data
- Fitting lines and curves to data
- Correlations and other measures of relations
- Use and misuse of statistics

2 Performance Expectations

2.1 Knowing

2.1.1 Representing

- Select an appropriate representation
- Construct an appropriate informal representation for the subject (e.g. a sketch)
- Construct a formal representation governed by strict construction procedures (e.g. geometric construction)

2.1.2 Recognizing Equivalents

- Indicate recognition of an equivalence by identification or selection
- Construct an object equivalent to a given object or two equivalent objects of a certain category
- Select or construct an object and its equivalent decomposition or two equivalent decompositions (e.g. prime factorizations of whole numbers, matrix products, etc.)

2.1.3 Recalling Mathematical Objects and Properties

- Recalling mathematical objects and properties
- Recognizing mathematical objects and properties

2.2 Using Routine Procedures

2.2.2 Performing Routine Procedures

2.2.2.1 Counting

2.2.2.2 Computing

- Identify an appropriate single computational operation
- Identify an appropriate single computational method
- Predict the effect of a computation operation or method
- Perform a single computational operation (e.g. multiply decimal fractions or matrices)
- Compute without aid of a computational device using an ad hoc procedure
- Compute without aid of a computational device using a known algorithm or procedure
- Compute by use of a formula (e.g. compute a mean)
- Compute using results of a simulation (e.g. find a probability on the basis of simulated experiment)
- Compute using inference and properties of a model (e.g. find a probability using a simple probability model)

2.2.2.5 Measuring

- Measure a physical object, iconic (pictorial) image or geometric figure in either standard or non-standard units
- Identify a measurable attribute of a physical object or image

- Select an appropriate unit for a given measurement
- Select an appropriate tool for a given measurement
- Select an appropriate degree of accuracy for a measurement in a given situation and task

2.2.3 Using more complex procedures

2.2.3.2 Using data

- Collect data by surveys, samples, measurement, etc.
- Organize data by tallies, categorization, etc.
- Construct a data display (e.g. non-coordinate graph, frequency distribution, etc.)
- Read, interpret a data display and/or use it to answer a question
- Choose an appropriate data display for a given communication or problem-solving situation
- Fit a curve of a given type to a set of data

2.3 Investigating and problem solving

2.3.3 Solving

- Solve a problem requiring a single step or operation
- Solve a problem requiring more than one step or operation
- Solve by transforming a representation (e.g. solve equations by algebraic manipulations to yield a sequence of equivalent equations)
- Solve the same problem in alternative ways using differing representations

Table 5. Common content and performance expectations in Grade 6, based on an analysis of textbooks in mathematics

Number of countries in the analysis= 33

List of countries: Afghanistan; Argentina; Brazil; Cambodia; Chile; China; China, Special Administrative Region of Hong Kong; China (Shanghai); China (Taiwan); Colombia; Costa Rica; Dominican Republic; Egypt; India; Iran; Indonesia; Jordan; Lebanon; Mexico; Pakistan; Palestine; Paraguay; Peru; Philippines; Senegal; Sri Lanka; South Sudan; Thailand; Uganda; United Arab Emirates; Uzbekistan; Venezuela; Viet Nam.

1 Mathematics Content

1.1 Numbers

1.1.1 Whole Numbers

1.1.1.1 Meaning

- The uses of numbers
- Place value & numeration
- Ordering & comparing numbers

1.1.1.2 Operations

- Addition
- Subtraction
- Multiplication
- Division
- Mixed Operations

1.1.2 Fractions & Decimals

1.1.2.1 Common Fractions

- Meaning & representation of common fractions
- Computations with common fractions & mixed numbers

1.1.2.2 Decimal Fractions

- Meaning & representation of decimals
- Computations with decimals

1.1.2.3. Relationships of Common & Decimal Fractions

- Conversion to equivalent forms
- Ordering of fractions & decimals

1.1.2.4 Percentages

- Percent computations
- Various types of percent problems

1.2 Measurement

1.2.1 Measurement Units

- Concept of measure (including non-standard units)
- Standard units (including metric system)
- Use of appropriate instruments
- Common measures (length, area, volume, time, calendar, money, temp, mass, weight, angles)
- Quotients and products of units (km/h, m/s, etc.)
- Dimensional analysis

1.2.2 Computations & Properties of Length, Perimeter, Area & Volume

- Computations, formulas and properties of length and perimeter
- Computations, formulas and properties of area
- Computations, formulas and properties of surface area
- Computations, formulas and properties of volumes

1.3 Geometry: Position, Visualization & Shape

1.3.2 2-D Geometry: Basics

- Points, lines, segments, half-lines and rays
- Angles
- Parallelism and perpendicularity

- 1.3.3 2-D Geometry: Polygons & Circles**
 - Triangles and quadrilaterals: their classification and properties
 - Pythagorean Theorem and its applications
 - Other polygons and their properties
 - Circles and their properties

- 1.3.4 3-D Geometry**
 - 3-dimensional shapes and surfaces and their properties
 - Planes and lines in space
 - Spatial perception and visualization
 - Coordinate systems in three dimensions
 - Equations of lines, planes and surfaces in space

1.5 Proportionality

- 1.5.1 Proportionality Concepts**
 - Meaning of ratio and proportion
 - Direct and inverse proportion

1.7 Data Representation, Probability & Statistics

- 1.7.1 Data Representation & Analysis**
 - Collecting data from experiments and simple surveys
 - Representing data
 - Interpreting tables, charts, plots, graphs
 - Kinds of scales (nominal, ordinal, interval, ratio)
 - Measures of central tendency
 - Measures of dispersion
 - Sampling, randomness and bias related to data samples
 - Prediction and inferences from data
 - Fitting lines and curves to data
 - Correlations and other measures of relations
 - Use and misuse of statistics

2 Performance Expectations

2.1 Knowing

- 2.1.1 Representing**
 - Select an appropriate representation
 - Construct an appropriate informal representation for the subject (e.g. a sketch)
 - Construct a formal representation governed by strict construction procedures (e.g. geometric construction)
- 2.1.2 Recognizing Equivalents**
 - Indicate recognition of an equivalence by identification or selection
 - Construct an object equivalent to a given object or two equivalent objects of a certain category
 - Select or construct an object and its equivalent decomposition or two equivalent decompositions (e.g. prime factorizations of whole numbers, matrix products, etc.)
- 2.1.3 Recalling Mathematical Objects and Properties**
 - Recalling mathematical objects and properties
 - Recognizing mathematical objects and properties

2.2 Using Routine Procedures

2.2.1 Using Equipment

- 2.2.1.1** Using instruments, for example, measuring instruments

2.2.2 Performing Routine Procedures

- 2.2.2.2** Computing
 - Identify an appropriate single computational operation
 - Identify an appropriate single computational method
 - Predict the effect of a computation operation or method
 - Perform a single computational operation (e.g. multiply decimal fractions or matrices)
 - Compute without aid of a computational device using an ad hoc procedure
 - Compute without aid of a computational device using a known algorithm or procedure
 - Compute by use of a formula (e.g. compute a mean)

- Compute using results of a simulation (e.g. find a probability on the basis of simulated experiment)
- Compute using inference and properties of a model (e.g. find a probability using a simple probability model)

2.2.2.5 Measuring

- Measure a physical object, iconic (pictorial) image or geometric figure in either standard or non-standard units
- Identify a measurable attribute of a physical object or image
- Select an appropriate unit for a given measurement
- Select an appropriate tool for a given measurement
- Select an appropriate degree of accuracy for a measurement in a given situation and task

2.3 Investigating and Problem Solving

2.3.3 Solving

- Solve a problem requiring a single step or operation
- Solve a problem requiring more than one step or operation
- Solve by transforming a representation (e.g. solve equations by algebraic manipulations to yield a sequence of equivalent equations)
- Solve the same problem in alternative ways using differing representations

Table 6. Common content and performance expectations in Grades 5 and 6, based on an analysis of textbooks in mathematics

Number of countries in the analysis = 31

List of countries: Argentina; Brazil; Cambodia; Chile; China; China, Special Administrative Region of Hong Kong; China (Shanghai); China (Taiwan); Colombia; Costa Rica; Dominican Republic; Egypt; India; Iran; Indonesia; Jordan; Lebanon; Mexico; Pakistan; Palestine; Paraguay; Peru; Philippines; Senegal; Sri Lanka; Thailand; Uganda; United Arab Emirates; Uzbekistan; Venezuela; Viet Nam.

1 Mathematics Content

1.1 Numbers

1.1.1 Whole Numbers

1.1.1.1 Meaning

- The uses of numbers
- Place value & numeration
- Ordering & comparing numbers

1.1.1.2 Operations

- Addition
- Subtraction
- Multiplication
- Division
- Mixed Operations

1.1.1.3 Properties of Operations

- Associative properties
- Commutative properties
- Identity properties
- Distributive properties
- Other number properties

1.1.2 Fractions & Decimals

1.1.2.1 Common Fractions

- Meaning & representation of common fractions
- Computations with common fractions & mixed numbers

1.1.2.2 Decimal Fractions

- Meaning & representation of decimals
- Computations with decimals

1.1.2.3 Relationships of Common & Decimal Fractions

- Conversion to equivalent forms
- Ordering of fractions & decimals

1.1.2.4 Percentages

- Percent computations
- Various types of percent problems

1.1.2.5 Properties of Common & Decimal Fractions

- Associative properties
- Commutative properties
- Identity properties
- Inverse properties
- Distributive properties
- Cancellation properties
- Other number properties

1.1.4 Other Numbers & Number Concepts

1.1.4.4 Number Theory

- Primes & Factorization
- Elementary number theory, etc.

1.2 Measurement

1.2.1 Measurement Units

- Concept of measure (including non-standard units)
- Standard units (including metric system)
- Use of appropriate instruments
- Common measures (length, area, volume, time, calendar, money, temp, mass, weight, angles)
- Quotients and products of units (km/h, m/s, etc.)
- Dimensional analysis

1.2.2 Computations & Properties of Length, Perimeter, Area & Volume

- Computations, formulas and properties of length and perimeter
- Computations, formulas and properties of area
- Computations, formulas and properties of surface area
- Computations, formulas and properties of volumes

1.3 Geometry: Position, Visualization & Shape

1.3.1 1-D & 2-D Coordinate Geometry

- Line and coordinate graphs
- Equations of lines in a plane
- Conic sections and their equations

1.3.2 2-D Geometry: Basics

- Points, lines, segments, half-lines and rays
- Angles
- Parallelism and perpendicularity

1.3.3 2-D Geometry: Polygons & Circles

- Triangles and quadrilaterals: their classification and properties
- Pythagorean Theorem and its applications
- Other polygons and their properties
- Circles and their properties

1.3.4 3-D Geometry

- 3-dimensional shapes and surfaces and their properties
- Planes and lines in space
- Spatial perception and visualization
- Coordinate systems in three dimensions
- Equations of lines, planes and surfaces in space

1.5 Proportionality

1.5.1 Proportionality Concepts

- Meaning of ratio and proportion
- Direct and inverse proportion

1.5.2 Proportionality Problems

- Solving proportional equations
- Solving practical problems with proportionality
- Scales (maps and plans)
- Proportion based on similarity

1.7 Data Representation, Probability & Statistics

1.7.1 Data Representation & Analysis

- Collecting data from experiments and simple surveys
- Representing data
- Interpreting tables, charts, plots, graphs
- Kinds of scales (nominal, ordinal, interval, ratio)
- Measures of central tendency
- Measures of dispersion
- Sampling, randomness, and bias related to data samples
- Prediction and inferences from data
- Fitting lines and curves to data
- Correlations and other measures of relations
- Use and misuse of statistics

2 Performance Expectations

2.1 Knowing

2.1.1 Representing

- Select an appropriate representation
- Construct an appropriate informal representation for the subject (e.g. a sketch)
- Construct a formal representation governed by strict construction procedures (e.g. geometric construction)

2.1.2 Recognizing Equivalents

- Indicate recognition of an equivalence by identification or selection
- Construct an object equivalent to a given object or two equivalent objects of a certain category
- Select or construct an object and its equivalent decomposition or two equivalent decompositions (e.g. prime factorizations of whole numbers, matrix products, etc.)

2.1.3 Recalling Mathematical Objects and Properties

- Recalling mathematical objects and properties
- Recognizing mathematical objects and properties

2.2 Using Routine Procedures

2.2.1 Using Equipment

- 2.2.1.1 Using instruments, for example, measuring instruments

2.2.2 Performing Routine Procedures

2.2.2.1 Counting

2.2.2.2 Computing

- Identify an appropriate single computational operation
- Identify an appropriate single computational method
- Predict the effect of a computation operation or method
- Perform a single computational operation (e.g. multiply decimal fractions or matrices)
- Compute without aid of a computational device using an ad hoc procedure
- Compute without aid of a computational device using a known algorithm or procedure
- Compute by use of a formula (e.g. compute a mean)
- Compute using results of a simulation (e.g. find a probability on the basis of simulated experiment)
- Compute using inference and properties of a model (e.g. find a probability using a simple probability model)

2.2.2.3 Graphing

- Construct a coordinate graph by performing computations if necessary and plotting one or more points. Multiple points may be left unconnected, connected with line segments in a line graph, or connected by a smooth curve approximating that which would be obtained by extrapolating between points
- Construct a coordinate graph by use of known properties of the object being graphed (usually assigning of at least one point specifically, for example, a y-intercept)
- Construct a coordinate graph by use of a graphing calculator or microcomputer (no manual point assignment)

2.2.2.5 Measuring

- Measure a physical object, iconic (pictorial) image or geometric figure in either standard or non-standard units
- Identify a measurable attribute of a physical object or image
- Select an appropriate unit for a given measurement
- Select an appropriate tool for a given measurement
- Select an appropriate degree of accuracy for a measurement in a given situation and task

2.2.3 Using More Complex Procedures

2.2.3.1 Estimating

- Decide when an estimate rather than an exact answer is appropriate
- Estimate a single quantity (e.g. a count)
- Estimate a ratio (e.g. of shaded area to total area in a geometric figure)
- Estimate a measurement (possibly including partitioning the figure)
- Estimate a result of a computational operation or procedure

- Decide if the result of an exact computation is reasonable by performing an approximate computation, mentally or explicitly
- Identify the range of a ‘good estimate’
- Round a quantity using an algorithm or representation (e.g. a number line)
- Select a number closest in size to a number of another type (e.g. fraction to whole number)
- Approximate by an algorithmic or iterative procedure (e.g. approximate a zero of a polynomial by iteration)

2.2.3.2 Using Data

- Collect data by surveys, samples, measurement, etc.
- Organize data by tallies, categorization, etc.
- Construct a data display (e.g. non-coordinate graph, frequency distribution, etc.)
- Read, interpret a data display and/or use it to answer a question
- Choose an appropriate data display for a given communication or problem-solving situation
- Fit a curve of a given type to a set of data

2.2.3.4 Classifying

- Recognize examples and non-examples of a class of objects (e.g. proportions)
- Classify mathematics objects by implicit criteria (e.g. geometric shapes)
- Classify mathematics objects by explicit criteria
- Identify properties defining a class (e.g. shapes, symmetries, similarities or congruencies by behaviour under specified transformations, etc.)
- Select or state the formal defining properties of a class

2.3 Investigating and Problem Solving

2.3.1 Formulating and Clarifying Problems and Situations

- Construct a verbal or symbolic statement of a real-world or other situation in which a mathematical problem goal can be specified
- Simplify a real-world or other problem situation by selecting aspects and relationships to be captured in a representation modelling the situation
- Select or construct a mathematical representation of a real-world situation or other problem situation
- Select or construct a mathematical representation of a problem (real-world or other problem situation plus a related question/goal)
- Compare and contrast two real world situations with quantitative aspects (e.g. by using measurements of each or quantities associated with each)
- Describe the effect of a change in a situation (e.g. the effect on its graph of changing a parameter)
- Determine data or the range of data needed to solve a data-related problem

2.3.3 Solving

- Solve a problem requiring a single step or operation
- Solve a problem requiring more than one step or operation
- Solve by transforming a representation (e.g. solve equations by algebraic manipulations to yield a sequence of equivalent equations)
- Solve the same problem in alternative ways using differing representations

Table 7. Common content and performance expectations in Grades 6, based on an analysis of curriculum statements and guidelines in reading

Number of countries in the analysis = 23

List of countries: Bahamas, Bermuda, Botswana, Cambodia, Caribbean, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Jamaica, Lesotho, Mexico, Nicaragua, Pakistan, Panama, Paraguay, Peru, Philippines, South Africa, Sri Lanka, Thailand.

2. Performance Expectations (*skills/competences to be acquired*)

2.1. Literal Comprehension (elements EXPLICITLY found in the text)

2.1.1. Explicit information found in the text

- Identify
- Extract
- Find
- Remember

2.2. Inferential comprehension (use/handling of IMPLICIT elements in the text)

2.2.1. Types of inference, according to the operation

- Differentiate
- Compare
- Deduct
- Generalize
- Apply
- Interpret
- Reorganize
- Relate/Connect
- Summarize
- Paraphrase
- Include

2.3. Value or evaluative comprehension (judge reading elements against values, norms and criteria)

2.3.1. Judgements about

- Precision-vagueness
- Coherence-incoherence
- Complexity-simplicity
- Validity and/or reliability
- Completeness of the information
- The probability or plausibility
- The contrast with values and/or personal experience
- The contrast with socio-cultural values or experiences

Table 8. Common content and performance expectations in Grades 5 and 6, based on an analysis of curriculum statements and guidelines in reading

Number of countries in the analysis = 25

List of countries: Bahamas; Bermuda; Botswana; Cambodia; Caribbean; Chile; China, Special Administrative Region of Hong Kong; China (Taiwan); Colombia; Costa Rica; Dominican Republic; El Salvador; Guatemala; Jamaica; Lesotho; Mauritius; Mexico; Nicaragua; Pakistan; Panama; Paraguay; Peru; Philippines; Sri Lanka; Thailand.

1. Content

1.1 Types of written texts

1.1.54 Poem

1.3. Function

1.1.1. Informative

2. Performance Expectations (*skills/competences to be acquired*)

2.4. Literal comprehension (elements explicitly found in the text)

2.4.2. Explicit information found in the text

- Identify
- Extract
- Find
- Remember

2.5. Inferential comprehension (use/handling of IMPLICIT elements in the text).

2.5.1. Types of inference, according to the operation

- Differentiate
- Compare
- Deduct
- Generalize
- Apply
- Interpret
- Reorganize
- Relate/Connect
- Summarize
- Paraphrase
- Include

2.6. Value or evaluative comprehension (judge reading elements against values, norms and criteria)

2.6.1. Judgements about

- Precision-vagueness
- Coherence-incoherence
- Complexity-simplicity
- Validity and/or reliability
- Completeness of the information
- The probability or plausibility
- The contrast with values and/or personal experience
- The contrast with socio-cultural values or experiences

Table 9. Common content and performance expectations in Grade 6, based on an analysis of textbooks in reading

Number of countries in the analysis= 32

List of countries: Argentina; Bahamas; Brazil; Cambodia; China; China, Special Administrative Region of Hong Kong; China (Shanghai); China (Taiwan); Colombia; Costa Rica; Dominican Republic; Egypt; Ghana; India; Indonesia; Jordan; Lebanon; Libya; Mexico; Pakistan; Palestine; Paraguay; Peru; Philippines; Saint Lucia; Syria; Thailand; Uganda; United Arab Emirates; Uzbekistan; Venezuela; Viet Nam.

1. Content

1.1 Types of written texts

1.1.13 Story/Tale

1.1.54 Poem

1.2 Acts of Speech

1.2.18 Dialogue

1.3 Function

1.3.1 Informative

1.4 Types of Plot

1.4.2 Narrative

1.4.3 Descriptive

2. Performance Expectations (*skills/competences to be acquired*)

2.1 Literal comprehension (elements explicitly found in the text)

2.1.1 Explicit information found in the text

- Identify
- Extract
- Find
- Remember

2.2 Inferential comprehension (use/handling of implicit elements in the text).

2.2.1 Types of inference, according to the operation

- Differentiate
- Compare
- Deduct
- Generalize
- Apply
- Interpret
- Reorganize
- Relate/Connect
- Summarize
- Paraphrase
- Include

Table 10. Common content and performance expectations in Grades 5 and 6, based on an analysis of textbook in reading

Number of countries in the analysis = 29

List of countries: Argentina; Bahamas; Brazil; Cambodia; China; China, Special Administrative Region of Hong Kong; China (Taiwan); Colombia; Costa Rica; Dominican Republic; Egypt; Ghana; India; Indonesia; Jordan; Lebanon; Libya; Mexico; Pakistan; Palestine; Paraguay; Saint Lucia; Syria; Thailand; Uganda; United Arab Emirates; Uzbekistan; Venezuela; Viet Nam.

1. Content

1.1. Types of written texts

1.1.6 Biography

1.1.7 Letter

1.1.13 Story/Tale

1.1.52 Play

1.1.54 Poem

1.1.61 Historic account

1.2 Acts of Speech

1.2.18 Dialogue

1.3 Function

1.3.1 Informative

1.4 Types of Plot

1.4.1 Narrative

1.4.2 Descriptive

1.4.3 Explanatory, expositive

1.6. Structural Elements of the Plot

1.6.1 Categories and types of relations

- Cause
- Effect
- Problem
- Solution
- Event (occurrence)
- Opinion
- Information, facts (statistical, nutritional)
- Anecdote
- Explanation
- Details (characteristics)
- Message (moral)
- Object
- Ingredient
- Preparation
- Motivation (motive, issue, interest)
- Environment (context, atmosphere, time, place)
- Action
 - Order (lineal, half of the story, at the end)
 - Type

1.6.2 Narrative point of view

- In first person
- In second person
- In third person

1.12. Reading mode

- Out loud
- In silence
- Scanning and Skimming

- 2. Performance Expectations (*skills/competences to be acquired*)**
 - 2.1. Literal comprehension (elements explicitly found in the text)**
 - 2.1.1. Explicit information found in the text**
 - Identify
 - Extract
 - Find
 - Remember
 - 2.2. Inferential comprehension (use/handling of implicit elements in the text).**
 - 2.2.1. Types of inference, according to the operation**
 - Differentiate
 - Compare
 - Deduct
 - Generalize
 - Apply
 - Interpret
 - Reorganize
 - Relate/Connect
 - Summarize
 - Paraphrase
 - Include
 - 2.4 Metacomprehension**
 - 2.4.4 Generate mental images**

Annex 1

Table A1.1 Year(s) of Publication of Curriculum Guidelines, by Country

Country	Mathematics				Reading				Mathematics & Reading			
	Grades 4–6	Grade 4	Grade 5	Grade 6	Grades 4–6	Grade 4	Grade 5	Grade 6	Grades 4–6	Grade 4	Grade 5	Grade 6
Arab States												
Egypt				2005/2006								
Jordan	2005				2005							
Lebanon												
Libya												
Palestine												
Qatar	2004											
South Sudan												
Syrian Arab Republic												
Tunisia					n.a.							
United Arab Emirates												
Central Asia												
Armenia									n.a.			
Kyrgyzstan									2009			
Mongolia												
Uzbekistan												
East Asia and the Pacific												
Beijing												
Cambodia	2006	2001	2001	2001	2006		2001					
China	n.a.				2000							
China, Hong Kong SAR	2002				2004–08							
China (Shanghai)												
China (Taiwan)	n.a.				2008			2007				
Indonesia												
Japan*												
Papua New Guinea	2003											
Philippines	n.a.				n.a.							
Singapore	2007				2008							
Thailand	2001–08				2001–08							
Viet Nam			2009	2009	2006							
Eastern Caribbean												
Caribbean					2005–08							
Latin America & Caribbean												
Argentina		2008–10	2008–10	2008–10		2009			2005		n.a.	
Bahamas			1999	1999		n.a.	n.a.	n.a.				
Brazil												
Belize		n.a.	n.a.	n.a.								

Bermuda*										2001-08	2001-08	2001-08
Chile	2009		2004	2004	2009		2004	2004	1998			
Colombia	2006				2006				2003			
Costa Rica	n.a.				n.a.							
Dominican Republic									1995			
Ecuador							n.a.		1997			
El Salvador									2008		2008	2008
Guatemala			2005	2005			2007	2007				
Jamaica										1999	1999	1999
Mexico					n.a.				2009			
Nicaragua											2008	2008
Panama			2006	2006			2006	2006				
Paraguay											2006	2006
Peru	1997-2006	1997	1997	1997	1997-2006				2008			
Saint Lucia												
Trinidad and Tobago	1999				1999							
Venezuela												
South and West Asia												
Afghanistan												
Bangladesh									2008			
Bhutan									2008			
India								n.a.				
Iran, Islamic Republic of												
Pakistan	2006				2006							
Sri Lanka				2006-07			2009	2007		2007		
Sub-Saharan Africa												
Angola	2003				2003							
Benin					2007							
Botswana	n.a.				n.a.				n.a.			
Burkina Faso									n.a.			
Ghana		2007	2007	2007		2007		2007				
Lesotho									n.a.	n.a.	n.a.	
Mauritius									n.a.			
Namibia	2005-07				2005							
Senegal									n.a.			
South Africa	2002		2002		2002			2002	2006			
Uganda									2004			
Western Europe												
Malta*		n.a.					n.a.					

n.a.: not available.

* The documents from these developed countries were not included in the analysis conducted for the report.

Table A1.2 Year(s) of Publication of Textbooks, by Country

Country	Mathematics				Reading			
	Grades 4–6	Grade 4	Grade 5	Grade 6	Grades 4–6	Grade 4	Grade 5	Grade 6
Arab States								
Egypt		2008/2009	2004/2005	2008/2009		2008/2009–2009/2010	2006/2007	2004/2005
Jordan		2006/2009	2006–2007/2009	2008/2009		2006/2009	2007/2009	2008/2009
Lebanon		2006		2007		2006–2008	2004–2007	2006–2007
Libya		n.a.	n.a.	n.a.		2008	2008	2008
Palestine		2005–2009	2007–2008	2007–2008		2008–2009	2007	2008
Qatar								
South Sudan		2002				2002		
Syrian Arab Republic						1999/2000–2002/2003	2000/2001–2003/2004	2002/2003–2003/2004
Tunisia		2009	n.a.	2008		2009	2008–2009	2007–2009
United Arab Emirates		2009	2009			n.a.	n.a.	
Central Asia								
Armenia								
Kyrgyzstan								
Mongolia		2006	2007	2005		2007	2007	
Uzbekistan		2007	2007	2008		2007	2007	2009
East Asia and the Pacific								
Beijing		2009	2006–2009	2009		2009	2009	2008–2009
Cambodia		2008	2007	2006		2009	2008	2007
China		2008–2009	2008–2009	2008–2009		2004–2008	2008–2009	2008–2009
China, Hong Kong SAR		2009	2009	2009		2006–2008	2006–2008	2006–2009
China (Shanghai)		2006–2009	2006–2007	2009		2003–2007	2005–2009	2009
China (Taiwan)		1998	1998	1998		1998–2010	1998–2010	1998–2010
Indonesia		2007	2006	2006		2007	2007	2007
Japan*		2006	2006	2006				
Papua New Guinea								
Philippines		2000	1987–2003	1999		1999	1999	1999–2008
Singapore						2010	2009	2008
Thailand	n.a.–n.a.	2007	2009	2009	n.a.	n.a.	2007	2008
Viet Nam		2007–2009	2009	2009		2009	2009	2009
Eastern Caribbean								
Caribbean								
Latin America & Caribbean								
Argentina		2007–2010	2008–2010	2007–2010		2009	2008–2009	2008–2009
Bahamas						2004	2004	2004
Brazil		2009	2009	2009		2009	2006	2006
Belize								

Bermuda*								
Chile		1995	2009	2009			2009	
Colombia		2001	2009	2007		2000	2007	2008
Costa Rica			2008	2008			2008	2005-2009
Dominican Republic		2001-2009	2001	2000-2001		2002-2004	1999-2001	2001-2005
Ecuador			2008	2008			2008	2008
El Salvador								
Guatemala								
Jamaica								
Mexico		1999-2009	2005	2009		1999-2009	2006-2008	2007-2009
Nicaragua								
Panama								
Paraguay			2007	2007			2007	2007
Peru		2009	2007-2009	2007-2009		2009	2009	2009
Saint Lucia		2003		2003		2000	2000-2005	2000
Trinidad and Tobago	2005-10					2006	2006	
Venezuela		2008	2007	2008		2005	2009	2008
South and West Asia								
Afghanistan				2004				
Bangladesh						2008	2008	
Bhutan								
India			n.a.	n.a.			n.a.	n.a.
Iran, Islamic Republic of		2007	2007	2007		2008	2008	2009
Pakistan		2004-2009	2004-2009			2005	2003-2009	
Sri Lanka		2000	2009	2007				2009
Sub-Saharan Africa								
Angola								
Benin								
Botswana								
Burkina Faso	1998	n.a.				1989	1992	1994
Ghana		2003	2005	2005		2008	2008	2008
Lesotho								
Mauritius								
Namibia								
Senegal		n.a.	2009	2009		2009	2001	2006
South Africa								
Uganda		2006	2008	2008		2008	2008	2008
Western Europe								
Malta*								

n.a.: not available.

* The documents from these developed countries were not included in the analysis conducted for the report.

Annex 2

Examples of 'segments' created from the table of contents of textbooks

Contents		
Syllabus Unit		Page
Revision exercise		1
Unit 1 Set of numbers	} Segment 1	5
Pupil self-assessment Unit 1		20
Unit 2 Operations on fractions	} Segment 2	22
Pupil self-assessment Unit 2		32
Unit 3 Numbers and numerals 0 to 10 000 000	} Segment 3	34
Pupil self-assessment Unit 3		42
Unit 4 Addition and subtraction (sums 0 to 9 999 999)	} Segment 4	44
Pupil self-assessment Unit 4		49
Unit 5 Decimal fractions and percentages	} Segment 5	51
Pupil self-assessment Unit 5		65
Assessment test Units 1 to 5		67
Unit 6 Measurement of length, capacity and mass	} Segment 6	70
Pupil self-assessment Unit 6		89
Unit 7 Ratio and proportion	} Segment 7	91
Pupil self-assessment Unit 7		101
Unit 8 Shape and space	} Segment 8	103
Pupil self-assessment Unit 8		115
Unit 9 Collecting and handling data	} Segment 9	117
Pupil self-assessment Unit 9		131

Mathematics textbook
from Ghana

Contents	
Unit 1: About Myself	2
Unit 2: Doing things	15
Unit 3: Visiting.....	23
Unit 4: Journeys	29
Unit 5: Something New	41
Unit 6: A Good Job	48
Unit 7: Looking at Animals	60
Unit 8: Hunting	71
Unit 9: Illness	80
Unit 10: careers	93
Unit 11: making things	103
Unit 12: Children in other Lands (1)	114
Unit 13: Children in other Lands (2)	123
Unit 14: Folk Stories	133

Each unit was identified as a separate segment.

Reading textbook from
South Sudan

While countries are seeking to reach the goal of universal primary education, the quality of its provision has come to the forefront. Improving learning outcomes is a critical global challenge in education, especially for developing countries. Despite attending primary school, many children fail to acquire a minimum level of literacy and numeracy skills and have a limited mastery of core subject knowledge.

This technical paper analyses the content of primary-level curricula and textbooks across 57 developing countries by reviewing their commonalities, national alignment and differences. Additionally, it examines expected student proficiencies in mathematics and reading by the end of the primary cycle. Under the auspices of the UIS Observatory of Learning Outcomes, the study fills a gap in the current pool of knowledge on curricular policies and shared standards in these core subject areas, an essential element for monitoring quality education.

The curricular materials which were collected, compiled and coded for this study form the basis of the newly established International Curriculum and Textbook Archive (ICATA). This evidentiary base provides the information required by educational stakeholders to devise alternative strategies and address timely policy and scholarly issues on primary school curricula and learning outcomes.



UNESCO
INSTITUTE
for
STATISTICS

UNESCO Institute for Statistics
P.O. Box 6128, Succursale Centre-Ville
Montreal, Quebec H3C 3J7
Canada
<http://www.uis.unesco.org>

The UNESCO Institute for Statistics (UIS) is the statistical office of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and is the UN depository for internationally comparable statistics in the fields of education, science and technology, culture and communication.