

An Overview of PIRLS 2006: Design, Results and Subsequent Analysis

Oliver Neuschmidt,
IEA Data Processing and Research Center

Ina V.S. Mullis and Michael O. Martin,
TIMSS & PIRLS International Study Center
Boston College

Abstract

PIRLS 2006 is an international reading assessment conducted at the fourth grade designed to measure trends in children's reading literacy achievement and to collect information about the policy and practices related to learning to read and reading instruction.

The paper will provide an overview of the purpose and the study design of the PIRLS 2006 assessment. It also will give a short summary of the major findings and present the methodological challenges that must be faced when analyzing the PIRLS 2006 data.

1 Overview of PIRLS

1.1 Introduction

The Progress in International Reading Literacy Study (PIRLS) is an international reading assessment providing internationally comparative data in order to help countries making informed decisions about reading education.

Inaugurated in 2001 and conducted on a regular 5-year cycle, PIRLS assesses students' reading achievement in primary school (the fourth grade in most countries). The results for the second cycle, PIRLS 2006, have been released in December 2007 and are the focus of this paper.

PIRLS is conducted by the International Association for the Evaluation of Educational Achievement (IEA), an independent international co-operative of

national research institutions and governmental agencies with a permanent secretariat based in Amsterdam, the Netherlands.

The IEA has been carrying out cross-national studies since 1959. Besides the PIRLS reading study, the following assessments are currently being conducted:

- TIMSS 2007
Trends in International Mathematics and Science Study
- TIMSS-Advanced
Replication of TIMSS 1995 Advanced Mathematics and Physics
- TEDS-M
Teacher Education and Development Study in Mathematics, and
- ICCS 2009
International Civic and Citizenship Education Study

Besides the results in reading literacy achievement, PIRLS 2006 collected a vast amount of information about the context of reading instruction in the participating countries. Children, parents, teachers and school administrators completed background questionnaires and provided details of home conditions, curricula and instructional practices in the area of reading competence, as well as about characteristics and policies specific to their schools.

1.2 Management

The TIMSS & PIRLS Study Center at Boston College is responsible for the overall direction and management, working closely together with a team of experts around the world.

The IEA Secretariat in Amsterdam communicates with the IEA member states and checks all elements of the proposed study. In addition, it is responsible for coordinating the verification of translations of the PIRLS test instruments and for recruiting the persons responsible for quality control.

The IEA Data Processing and Research Center (IEA DPC) is responsible for processing and verifying the data submitted by the participants as well as for assembling the final international database.

Statistics Canada in Ottawa is responsible for the weighting of data and, in cooperation with the IEA DPC, for drawing up representative school samples in the participating countries.

Education Testing Service in Princeton, New Jersey consults on psychometric methodology.

Each participating country designates an individual to be National Research Coordinator (NRC) who is responsible of implementing the study in his/her country in accordance with the international study guidelines.

1.3 Framework

The *PIRLS 2006 Assessment Framework and Specifications* is the basis for the PIRLS 2006 assessment of reading literacy. The Framework defines two major purposes for reading:

- for literary experience, and
- to acquire and use information.

Within each of these two major purposes, the following processes of reading comprehension are assessed:

- Focus on and retrieve explicitly stated information,
- Make straightforward inferences,
- Interpret and integrate ideas and information, and
- Examine and evaluate content, language, and textual elements.

1.4 Assessment Design

Given the broad coverage required by the PIRLS framework, the accompanying test instruments require extensive testing time, 6 hours and 40 minutes altogether.

Overall, 10 authentic text passages from original sources were selected (5 for the literary purpose and 5 for the informational purpose). To present at least some of the material in a more authentic setting, two blocks exclusively were included in a special PIRLS reader printed in color.

Each booklet contained two text passages followed by several multiple-choice and constructed response questions (126 items altogether).

So as not to overburden the children participating in PIRLS, a rotated assessment design was used: The passages along with their accompanying questions were rotated among the 13 booklets with administering only one single

booklet to each of the participating students according to a scientific sampling design.

| | PIRLS 2006 Booklets | | | | | | | | | | | | |
|--------|---------------------|----|----|----|----|----|----|----|----|----|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | R |
| Part 1 | L1 | L2 | L3 | L4 | I1 | I2 | I3 | I4 | L1 | I2 | L3 | I4 | L5 |
| Part 2 | L2 | L3 | L4 | I1 | I2 | I3 | I4 | L1 | I1 | L2 | I3 | L4 | I5 |

L1-5: literary blocks/ I1-5: informational blocks

Complementing the students' reading achievement results, PIRLS collected information about key factors related to students' home and school environments by administering questionnaires to the tested students, their parents, teachers, and school principals. Additionally, a curriculum questionnaire provided information about the reading curriculum.

School Questionnaire

Each principal of a selected PIRLS school was asked to complete a school questionnaire about the school context for teaching and learning. The school questionnaire asked about the school's demographic characteristics, the resources, and the school environment as well as about the curriculum and the use of materials to teach reading.

Teacher Questionnaire

Teachers of the assessed classes were asked to respond to the teacher questionnaire. The teacher questionnaire focused on teacher's preparation and professional development, their pedagogical activities, and the implemented curriculum.

Student Questionnaire

Each selected student completed a student questionnaire. The questionnaire included questions about the students' home background and reading habits, self-concept and attitudes towards reading as well as about classroom instructional practices.

Parent questionnaire

The parents of each selected student were asked to reply to a Learning to Read Survey asking about literacy-related activities, resources at home, and about parent's perceptions of support provided by the school environment.

1.5 Participants and Population

Altogether, 46 educational systems around the world participated in the PIRLS 2006 assessment. The target population was students enrolled in the fourth grade of formal schooling. For a representative sample, usually around 150 schools had to be sampled in the first stage per PIRLS participant. In a second step intact classrooms from the target grade were sampled all in all summing up to at least 4000 students in each of the participating countries.

Overall, PIRLS assessed about 215,000 students, 185,000 parents, 11,000 teachers, and 7,600 school principals.

2 PIRLS Results

Results from the PIRLS 2006 assessment, published in December 2007, were presented in the PIRLS 2006 International Report (Mullis, I.V.S., Martin, M.O., Kennedy, A.M., & Foy, P. 2007). Besides, participating countries contributed chapters to an "Encyclopedia" giving an overview on their educational system (Kennedy, A.M., Mullis, I.V.S., Martin, M.O., & Trong L.T. 2006). An overview on the technical specifications and the assessment design can be found in the PIRLS 2006 Technical Report (Martin, M.O., Mullis, I.V.S., & Kennedy, A.M. (Eds.). 2007).

Important findings from the PIRLS 2006 International Report are cited below:

General findings:

- The Russian Federation, Hong Kong SAR, and Singapore were the three top-performing countries in PIRLS 2006.
- The PIRLS 2006 participants with the highest average achievement overall, also tended to have the highest average achievement for literary and informational reading and for the comprehension processes.
- Girls had significantly higher reading achievement than boys in all except two countries (Luxembourg and Spain).
- For about half the PIRLS 2006 participants, almost all of their students demonstrated at least some basic reading competencies.

- In about half of the PIRLS 2006 participants, almost all students reached the Low International Benchmark.
- In about half of the participants, three fourths of the students reached the Intermediate Benchmark and about two fifths reached the High Benchmark.
- Singapore and the Russian Federation had the greatest percentages of high-achieving students, with about 19% reaching the Advanced Benchmark.

Home Activities Fostering Reading Literacy

- The report describes a positive relationship between students' reading achievement at the fourth grade and parents having engaged their children in early literacy activities before starting school (e.g. reading books, telling stories...)
- The presence of childrens' books in the home showed a strong relationship with reading achievement. The average reading achievement difference between students from homes with many children's books (>100) and those from homes with few books (10 or fewer) was almost one standard deviation (91 points)
- Average reading achievement was highest among students whose parents were frequent readers and whose parents had favorable attitudes toward reading

Student's Attitudes and Reading Habits

- Students with the most positive attitude towards reading had the highest reading achievement.
- On average across countries, students reported reading stories and novels outside of school more frequently than informational materials
- On average across countries, students reported spending more time in a typical day reading stories and articles in books or magazines than on the Internet (1.4hours vs. 1.0 hours).
- On average across countries, 40 percent of the students reported reading for fun on a daily basis, and 28 percent at least weekly.

Organization for Teaching Reading

- Internationally, there was a positive relationship between fourth-grade student's reading achievement, on average, and the amount of time spent in pre-primary education.
- Parents' assessments of their children's early literacy skills corresponded well with reading achievement in the fourth grade.
- Across the PIRLS 2006 countries, the average class size for fourth-grade reading instruction was 24 students. The range varied from 17 students in Luxembourg to 42 in South Africa.

- Teachers reported that 17 percent of their students, on average across countries, were in need of remedial reading instruction.

Teachers and Reading Instruction

- Students' teachers had been teaching for an average of 17 years
- Both principals and teachers reported that textbooks were the foundation of reading instruction, supplemented by other material
- The percentage of students whose teachers asked them to read literary texts at least once a week was greater than the percentage asked to read informational texts.
- Internationally, almost all students (89% on average) attended schools with libraries, and 69 percent had access to classroom libraries.
- On average across countries, 65 percent of students had access to computers in school, and 57 percent were in schools with Internet access.

School Context

- Internationally, the reading achievement of students in schools with few disadvantaged students (no more than 10%) was much higher (56 scale points) than for students with a high percentage of disadvantaged classmates.
- Principals reported that about half the students on average across countries were attending schools that were not hampered by resource shortages, while 15% on average attended schools where resource shortages greatly affected the provision of reading instruction. On average, there was a positive relationship between availability of school resources and average reading achievement
- Nearly half the students (48% on average) attended schools emphasizing home-school involvement, whereas about one fourth (27%) attended schools with little communication between the school and the home and little parental participation in the life of the school. There was a modest positive relationship between the level of home-school involvement and average reading achievement.
- Most students were in schools where principals reported that absenteeism either was not a problem (37 percent) or a minor problem (40%). Students in these schools had a higher average reading achievement than students attending schools where absenteeism was a serious problem.
- Internationally, the majority of teachers had a positive view of the teaching profession and their career and teaching.
- Students who agreed that they felt safe in their schools had a higher reading achievement than those who did not agree that they felt safe.

3 Analyzing the PIRLS 2006 Database

The PIRLS 2006 international database is aiming to support and promote secondary data analysis for improving reading education. It is made available for free on the website of the TIMSS and PIRLS International Study Center at Boston College <http://timssandpirls.bc.edu/pirls2006/index.html>.

The database contains student reading achievement data as well as student, parent, teacher, school and curricular background data for all of the altogether 46 PIRLS participants, which is available in SAS™ and SPSS™ format.

The *PIRLS 2006 User Guide* describes the content and format of the PIRLS 2006 database. It also presents example analyses using SPSS and SAS statistical software as well as the International Database (IDB) Analyzer©, an SPSS plug-in developed for user friendly analyses of IEA studies.

The Data CD of the User Guide also contains additional data documentation and supplements of the User Guide, such as data almanacs, a documentation of the national adaptations from the international questionnaires and a description of index construction for reporting.

3.1 Methodological Challenges to be considered when analyzing the data

The PIRLS sampling applied a stratified, multistage, cluster-sampling technique to the problem of selecting efficient and accurate samples of students while working with schools and classes.

Because of the complex sampling design, data analysis requires the correct usage of sampling weights in order to adjust for different sample selection probabilities as well as for non-responses.

Besides, these procedures complicate the task of computing standard errors to quantify sampling variability, as the computational formulas derived from assumptions of simple random sampling (like applied when using standard procedures in SAS and SPSS) generally underestimate the true variability in the data.

Additionally, each student's achievement on the entire assessment is measured by a three-parameter Item Response Theory (IRT) model depending on the

student's responses to the test booklet he/she took and the student's background characteristics. Because there is some error inherent in this imputation process, generally five estimates, or "plausible values," for each student on each of the scales (overall reading, literary experience, and acquire and use information) is drawn. Each student, therefore, has five estimates of his or her achievement on each of the scales and subscale measured.

Therefore it is very important to be able to quantify the uncertainty associated with these statistics.

In PIRLS & TIMSS, the jackknife procedure is used to provide a robust estimate of the standard error of each statistic presented in the International Reports. The jackknife standard errors include both an error component due to sampling variation and an error component due to variation among the five plausible values generated for each student. The standard errors may be used to create confidence intervals for statistics computed from the TIMSS data.

In order to correctly estimate the sampling and imputation errors resulting from the complex assessment design, it is absolutely necessary to apply the appropriate analysis procedures described above. SAS and SPSS macros from the International Database, as well as the International Database (IDB) Analyzer© (a plug-in for the Statistical Package for the Social Sciences (SPSS) developed by the IEA Data Processing and Research Center), for example, can be used to combine data files and analyze data from large scale assessments by giving a good estimation of the sampling and imputation errors associated with the calculated statistics.

4 References

Note: The material in this paper is summarized from the PIRLS 2006 reports and papers listed below.

Kennedy, A.M., Mullis, I.V.S., Martin, M.O., & Trong L.T. (2006). *PIRLS Encyclopedia*. Chestnut Hill, MA: Boston College.

Martin, M.O., Mullis, I.V.S., & Kennedy, A.M. (Eds.). (2007). *PIRLS 2006 Technical Report*. Chestnut Hill, MA: Boston College.

Mullis, I.V.S., Kennedy, A.M., Martin, M.O., & Sainsbury, M. (2006). *PIRLS 2006 Assessment Framework and Specifications, 2nd Edition*. Chestnut Hill, MA: Boston College.

Mullis, I.V.S., Martin, M.O., Kennedy, A.M., & Foy, P. (2007). *PIRLS 2006 International Report: IEA's Progress in International Reading Literacy Study in Primary Schools in 40 Countries*. Chestnut Hill, MA: Boston College.

Mullis, I.V.S. and Martin, M.O. (2008). *Assessment Methods in IEA's TIMSS and PIRLS International Assessments of Mathematics, Science, and Reading*, unpublished manuscript.

Neuschmidt, O. (2007): *International Data Base (IDB) Analyzer Demonstration* IAEA Conference Baku, unpublished Manuscript.