TRENDS INDICATORS OF STUDENT ACHIEVEMENT

ITEM RESPONSE THEORY SCALING OF LITERACY AND MATHEMATICS ACHIEVEMENT DATA FROM 1995 TO 1999 IN FIVE GRADES

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Christian Monseur

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INTRODUCTION

The Ministry of Education of Argentina has requested ACER to scale the student assessment data collected during five consecutive school years (1995 to 1999) on literacy and mathematics levels in five different grades.

This report presents the results of the scaling for the data that were submitted to ACER. The report focuses mainly on the population mean estimates, i.e. what was the average achievement level in mathematics for instance grade 5 students in 1995 in comparison with 1996 grade 5 students and so on.

This report consists of three sections. Section 1 includes the population estimates per grade and per domain across the different school years. Results are presented in tabular and graphical forms. The conclusions of the scaling process and some methodological recommendations are presented in the second section. The technical issues, including the scaling method, the sampling variance computation, multiple comparisons, file preparations for the final scaling, and the item parameter estimates are assembled in appendixes.

For each domain grade combination, the different results are presented through three tables and one figure. The first table provides, for each school year,

- *Ni,* the number of students used for the population parameter estimates;
- *Mean*, the mean estimate of the population, i.e. the average of the *Ni* student ability estimates[1];
- *SD*, the standard deviation of the *Ni* student ability estimates;
- *SE(mean)*, the standard error on the mean. The computation method of the standard error on the mean is described in *Appendix 1. Technical appendixes - sampling variance estimation* sub-section.
- *Prob,* the average expected probability of success of all students to all items. These probabilities are derived from the Rasch model. On the opposite of the absolute average percentage of correct answers, these averages of expected probabilities are on a common scale and are therefore comparable. *Appendix 1. Technical appendixes – Scaling method* provides a description of the model used and how to derive the average expected probability.

The figure presents the mean estimate and the confidence interval with a type I error of 0.05.

The second table presents the results of test of equality between the different means. If the result is 1, than the two means are considered as statistically different, i.e. it is unlikely that the difference could arise by chance. A result of 0 means that the two estimates are not statistically different. *Appendix 1. Technical appendixes – Multiple comparisons* gives details on how these comparisons were performed.

Finally, on the request of the Ministry of Education, all the data were re-scaled by dropping some items. The last table shows the mean estimates on the subset of items.

As the sample sizes were very large, nearly all tests of equality are statistically significant. To better appreciate the evolution from year to year, it is recommended to also analyse the average expected probabilities.

[1] The mean estimate was directly provided by CONQUEST. The standard deviation and sampling error estimates were computed with the plausible values assigned to each student.

ACHIEVEMENT RESULTS

GRADE 3

Language

Table 1: Mean and Standard Deviation Estimates[2].

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1996	37705	0.5707	1.0477	0.0158	0.6389
1997	36897	0.6217	0.9904	0.0161	0.6506
1998	44611	0.8596	1.1120	0.0158	0.7026
1999	39204	0.5706	1.1384	0.0177	0.6389

Figure 1: Mean estimates and 95% confidence interval

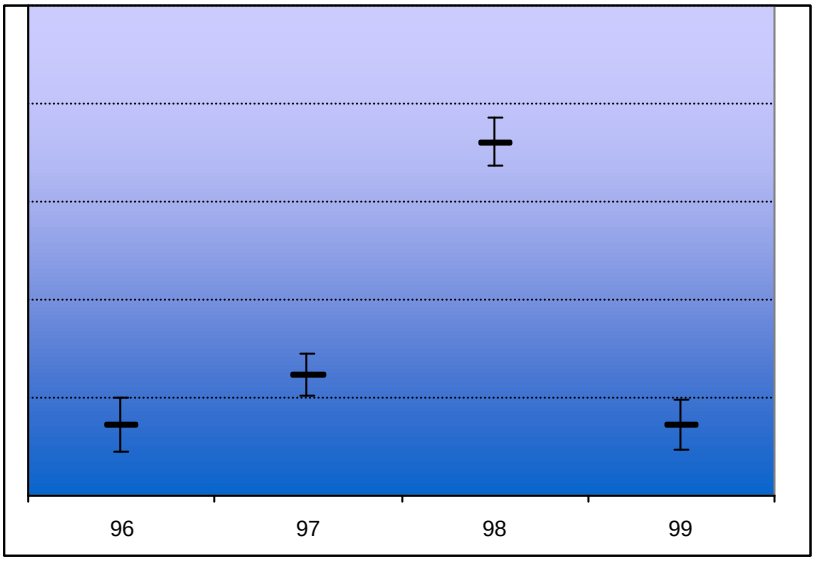


Table 2: Multiple comparisons.

	1997	*1998*	*1999*
1996	0	1	0
1997		1	0
1998			1

Table 3: Mean estimates on a subset of items

1996	*1997*	*1998*	*1999*
0.627	0.685	0.876	0.569

[2] As there is only one anchor item between 1995 test and the other ones, it is recommended to not compare 1995 results with the four next school year results. Therefore, the 1995 results are not included in the tables and in the figure and only the mean is provided in this footnote (1995 mean: 0.8475).

Mathematics

Table 4: Mean and Standard Deviation Estimates[3].

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1996	41386	0.4881	0.9218	0.0127	0.6197
1997	36634	0.6451	0.9416	0.0152	0.6559
1998	43114	0.6732	1.0070	0.0147	0.6622
1999	38130	0.2593	1.0089	0.0159	0.5645

Figure 2: Mean estimates and 95% confidence interval

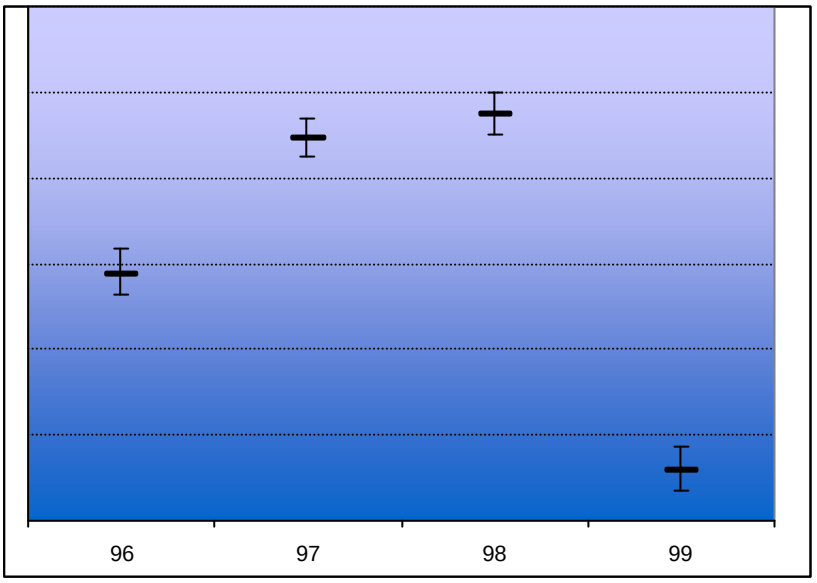


Table 5: Multiple comparisons.

	1997	*1998*	*1999*
1996	1	1	1
1997		0	1
1998			1

Table 6: Mean estimates on a subset of items

1996	*1997*	*1998*	*1999*
0.505	0.602	0.634	0.325

[3] As there is only one anchor item between 1995 test and the other ones, it is recommended to not compare 1995 results with the four next school year results. Therefore, the 1995 results are not included in the tables and in the figure and only the mean is provided in this footnote (1995 mean: 0.6774).

GRADE 5

Language

Table 7: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	29250	0.3441	0.9070	0.0138	0.5852
1995	31514	0.1711	0.8407	0.0126	0.5427
1997	28629	0.7733	0.8803	0.0052	0.6842
1998	31309	0.8689	0.9346	0.0053	0.7045
1999	31600	1.0606	0.9273	0.0052	0.7428

Figure 3: Mean estimates and 95% confidence interval

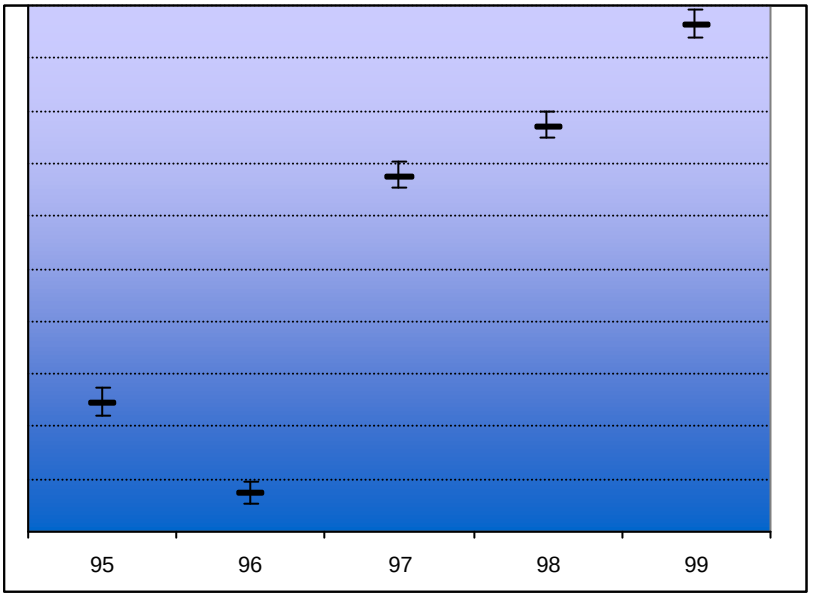


Table 8: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	1	1	1
1996		1	1	1
1997			1	1
1998				1

Table 9: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.359	0.267	0.872	0.880	1.029

Mathematics

Table 10: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	28094	0.161	0.9969	0.0188	0.5402
1995	32971	-0.0081	0.9170	0.0161	0.4980
1997	29949	0.5609	0.9682	0.0056	0.6367
1998	29803	0.7164	1.0681	0.0062	0.6718
1999	30047	1.0504	0.9966	0.0057	0.7409

Figure 4: Mean estimates and 95% confidence interval

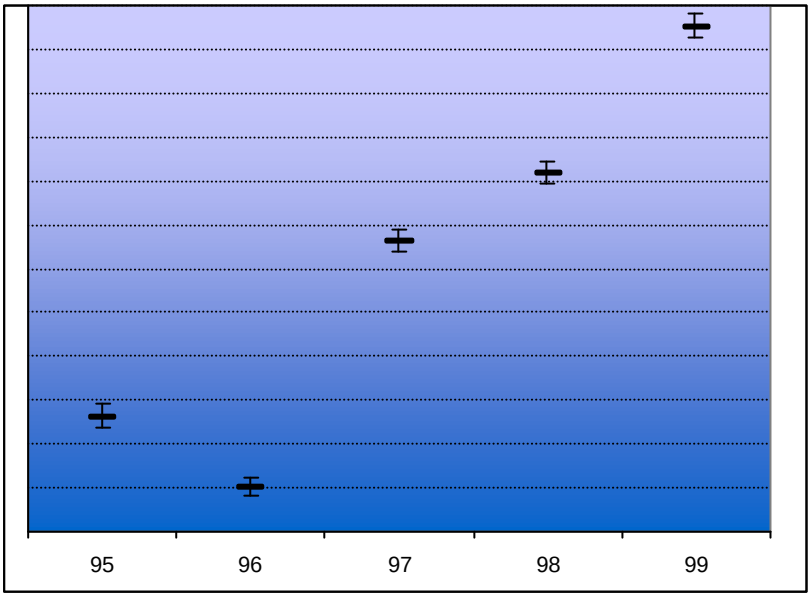


Table 11: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	1	1	1
1996		1	1	1
1997			1	1
1998				1

Table 12: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.153	-0.016	0.569	0.771	1.09

GRADE 6

Language

Table 13: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1996	11343	0.4482	0.9052	0.0207	0.6102
1997	40810	0.3196	0.9388	0.0125	0.5792
1998	41642	0.3972	0.9486	0.0125	0.5980
1999	36489	0.1235	0.9133	0.0127	0.5308

Figure 5: Mean estimates and 95% confidence interval

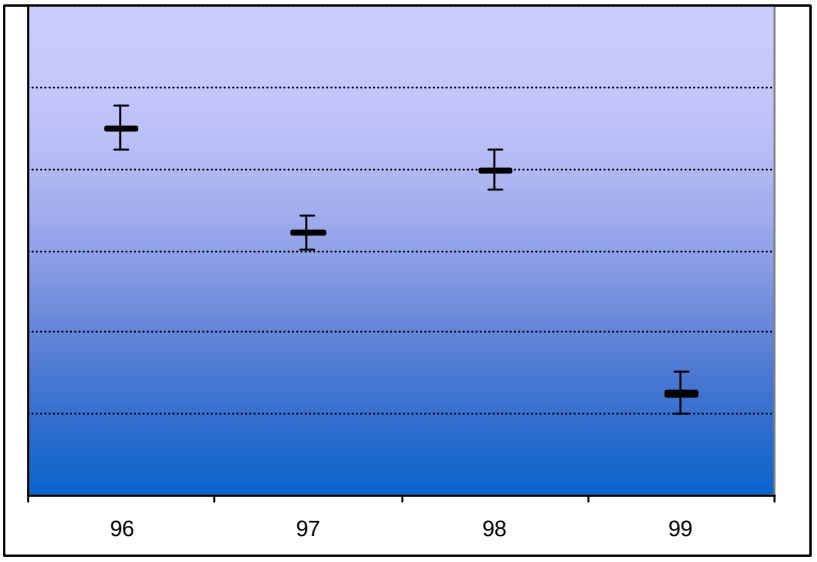


Table 14: Multiple comparisons.

	1997	*1998*	*1999*
1996	1	0	1
1997		1	1
1998			1

Table 15: Mean estimates on a subset of items

1996	*1997*	*1998*	*1999*
0.383	0.386	0.490	0.208

Mathematics

Table 16: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1996	11883	0.2797	0.8383	0.0212	0.5695
1997	39301	0.2124	0.9092	0.0134	0.5529
1998	40580	0.4278	0.9817	0.0136	0.6053
1999	36218	0.0992	1.0149	0.0140	0.5248

Figure 6: Mean estimates and 95% confidence interval

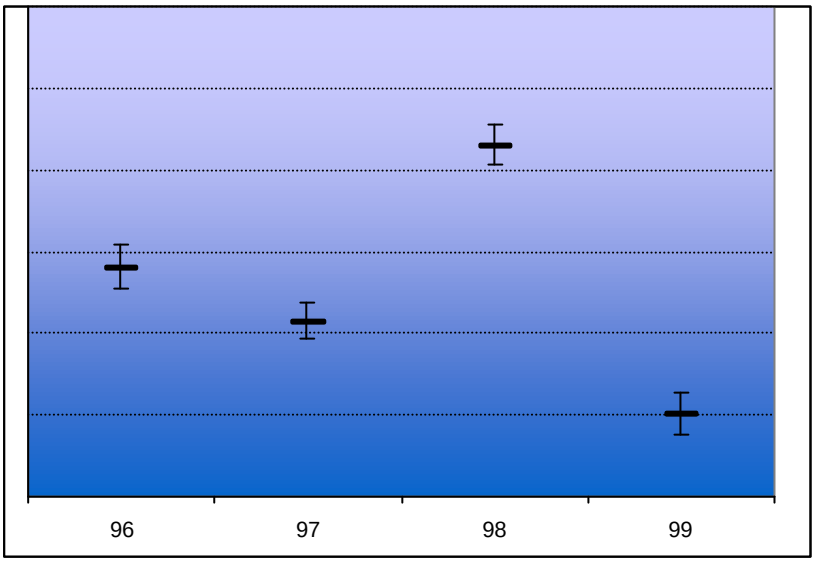


Table 17: Multiple comparisons.

	1997	*1998*	*1999*
1996	1	1	1
1997		1	1
1998			1

Table 18: Mean estimates on a subset of items

1996	*1997*	*1998*	*1999*
0.393	0.377	0.601	0.267

GRADE 7

Language

Table 19: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	33750	0.5736	0.9925	0.0155	0.6396
1995	34004	0.4331	0.9570	0.0151	0.6066
1997	37168	0.3997	0.9348	0.0136	0.5986
1998	34706	0.6011	1.0257	0.0147	0.6459
1999	29594	0.3559	0.9793	0.0152	0.5880

Figure 7: Mean estimates and 95% confidence interval

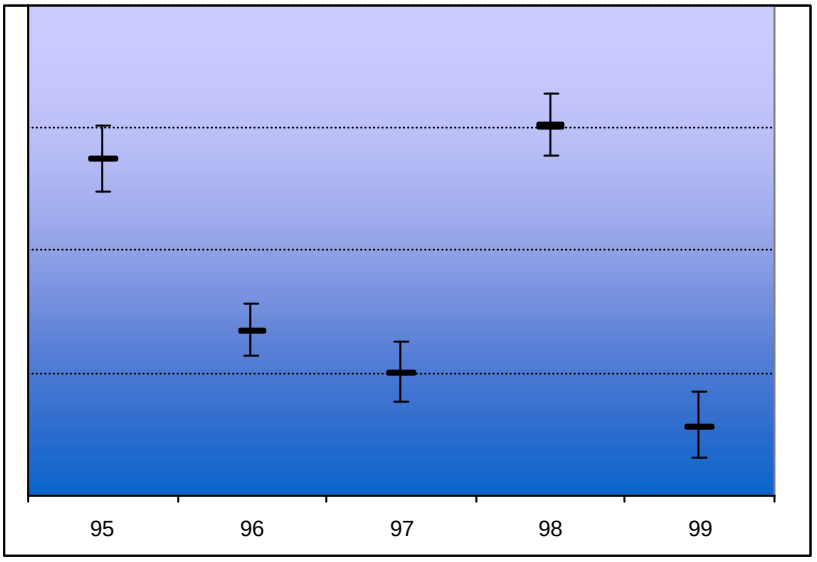


Table 20: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	1	0	1
1996		0	1	1
1997			1	0
1998				1

Table 21: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.601	0.466	0.430	0.624	0.378

Mathematics

Table 22: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	32996	0.1472	0.9987	0.0174	0.5367
1995	34204	0.2936	1.0057	0.0176	0.5729
1997	36324	0.2078	0.9756	0.0153	0.5518
1998	34725	0.1602	0.9935	0.0163	0.5400
1999	30399	-0.0852	0.9305	0.0159	0.4787

Figure 8: Mean estimates and 95% confidence interval

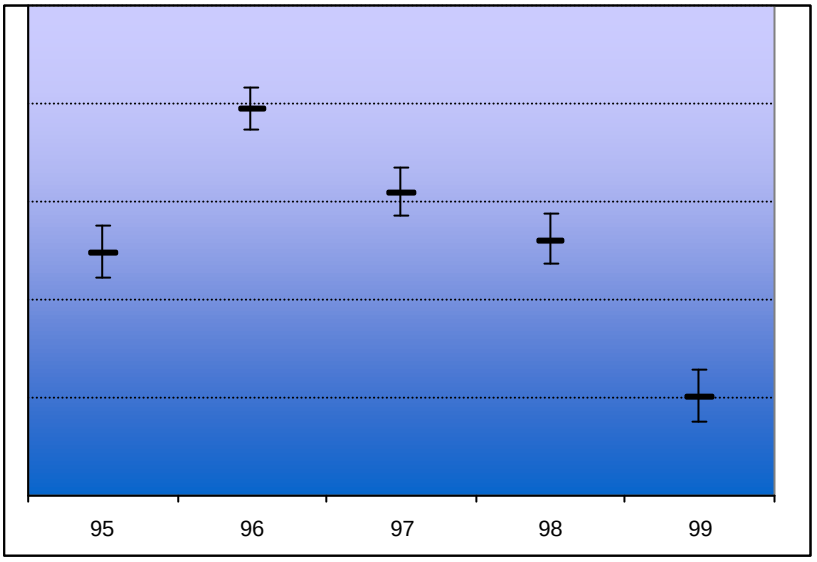


Table 23: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	0	0	1
1996		1	1	1
1997			0	1
1998				1

Table 24: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.106	0.281	0.187	0.130	-0.119

GRADE 9

Language

Table 25: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	36142	0.3621	0.8566	0.0138	0.5895
1995	48005	0.1765	0.8374	0.0109	0.5440
1997	38320	0.1534	0.8534	0.0125	0.5383
1998	39814	0.2375	0.8778	0.0131	0.5591
1999	40317	0.2809	0.9031	0.0135	0.5698

Figure 9: Mean estimates and 95% confidence interval

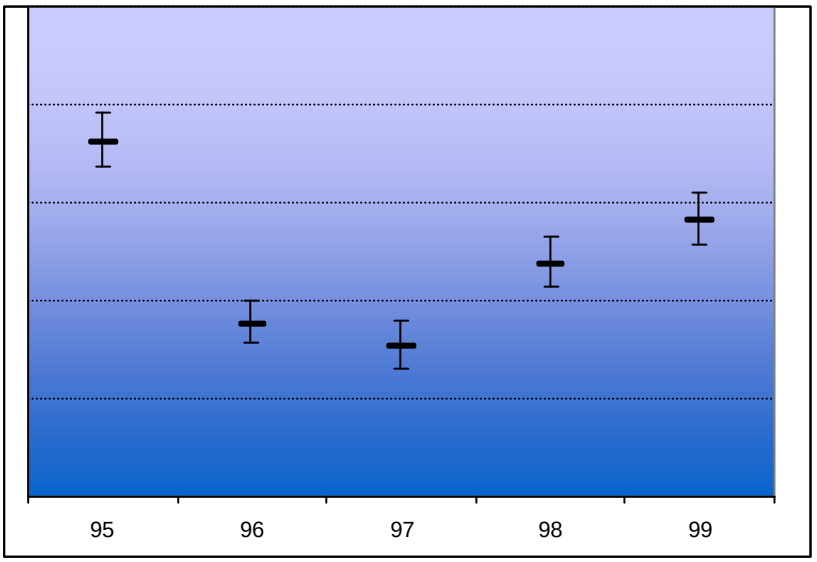


Table 26: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	1	1	1
1996		0	1	1
1997			1	1
1998				0

Table 27: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.362	0.211	0.189	0.278	0.325

Mathematics

Table 28: Mean and Standard Deviation Estimates.

Year	*Ni*	*Mean*	*SD*	*SE(mean)*	*Prob.*
1995	36348	0.1249	0.8724	0.0155	0.5312
1995	49337	-0.0194	0.9400	0.0135	0.4952
1997	38201	-0.1412	0.9036	0.0146	0.4648
1998	39075	0.0502	0.9267	0.0148	0.5125
1999	40584	0.0090	0.9377	0.0148	0.5022

Figure 10: Mean estimates and 95% confidence interval

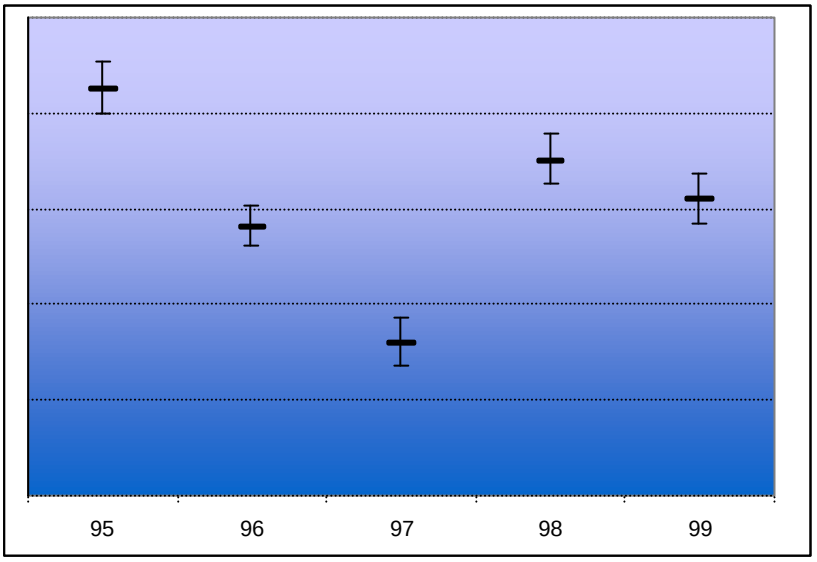


Table 29: Multiple comparisons.

	1996	*1997*	*1998*	*1999*
1995	1	1	1	1
1996		1	1	0
1997			1	1
1998				0

Table 30: Mean estimates on a subset of items

1995	*1996*	*1997*	*1998*	*1999*
0.126	-0.008	-0.112	0.084	0.046

CONCLUSIONS AND RECOMMENDATIONS

Figure 11 and Figure 12 summarise the achievement results by domain.

Figure 11: Trends Indicators of achievement in language

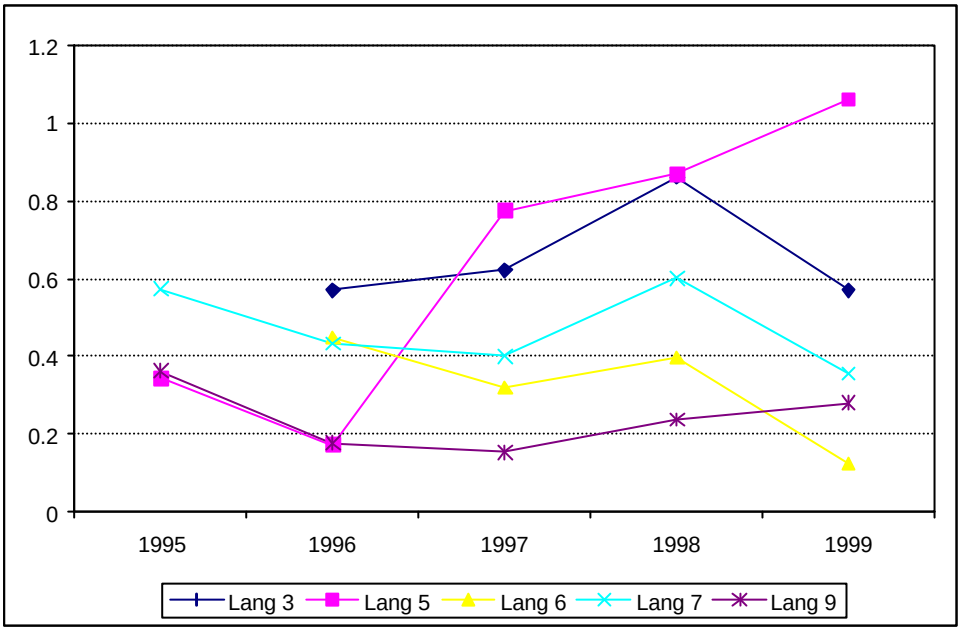
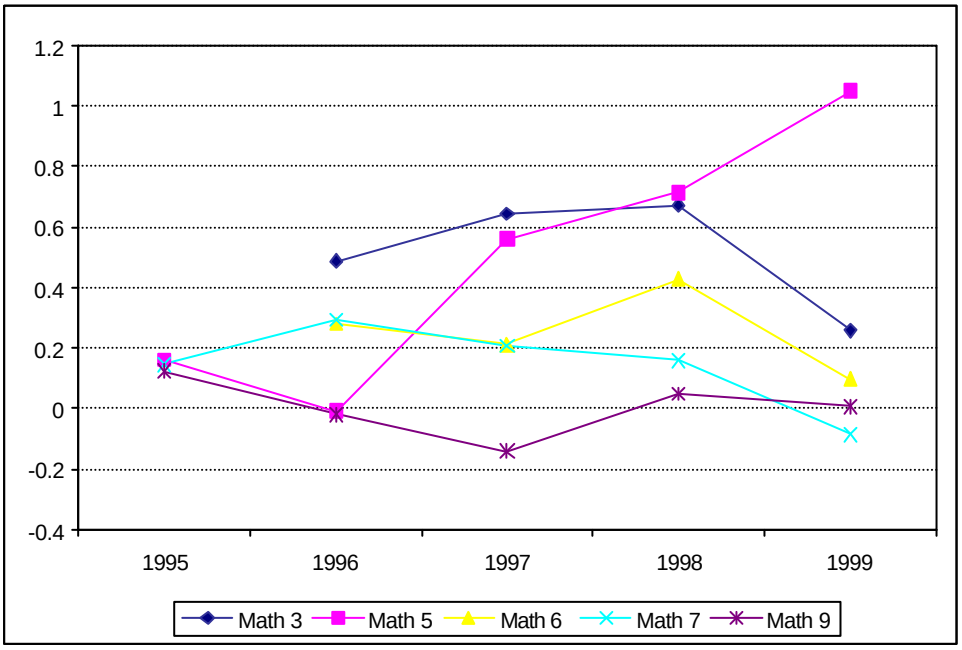


Figure 12: Trends Indicators of achievement in mathematics



These two figures show that the trends over time are independent of the domain.

- Grade 3, grade 6 and grade 7 results shows a substantial decrease between 1998 and 1999 and, in most cases, the 1998 results seems to the best among the different school years. As the 1998 results

are the best, there is usually an increase between 1997 and 1998. The previous results seem to be more or less stable.

- Grade 9 results show a decrease during the three first years and then the results start to improve. By 1999, they have almost returned to their 1995 level.
- Since 1996, grade 5 results show a quite surprising improvement from one school year to the next.

Broadly speaking, the range of changes from one school year to another one is large enough for raising some methodological issues that should be answer before drawing final conclusions.

- Were the assessment sessions standardised enough in terms of procedures and schedules to ensure the comparability of the data. It is usually recognised that students achieve better just before a long holiday period than just after. It should be advisable to check the period when the different testing sessions occured. The socio-political context might have a similar effect on the results. Were there any strikes just before a testing session and so on. Were the test administration guidelines explicit enough for each school year?
- Was the time allowed to student for completing the test accurate regarding the number of questions in the test?
- Was the test composition quite similar from one school year to another one? Were the different components of the test be given equal weights?
- And so on.

Grade 5 pattern also raises the question of the reliability of a census assessment with an equating study. As most of the linked items are used since 1995 in each school year test, teachers might expect the inclusion of these items in the next assessment and therefore might prepare their students to specifically answer them. With a census assessment, items cannot be regarded as confidential and their reuse for future tests might lead to an over-estimation of the progresses.

This last observation leads us to introduce four methodological recommendations which assume that these assessments have a monitoring but not a certification purpose.

- With the Rasch model used for the scaling, it is not necessary that linking items are the same from one school year to another one. It is recommended that for the next large assessment, linking items are selected from the whole existing item pool, from 1995 to 1999. In fact, it is not even necessary to maintain one of the current linking items in the new linking set. This wider set of possible linked items should decrease the bias observed with the grade 5 results.
- Under the assumption of monitoring purposes, it is not a requirement that each student receive the same questions. Different forms can be prepared and rotated among students within schools and within classes. This procedure enables to cover more widely the domain so that the construct validity of the test is improved. Nevertheless, the different forms need to be properly linked. Table 31 shows a example of a rotation design, which uses 7 forms of 30 questions each.

Table 31: Items allocation for a 7 form design.

Form	*Item set 1*	*Item set 2*	*Item set 3*
1	1-10	11-20	31-40
2	11-20	21-30	41-50
3	21-30	31-40	51-60
4	31-40	41-50	61-70
5	41-50	51-60	1-10
6	51-60	61-70	11-20
7	61-70	1-10	21-30

Each form consists of 30 items selected from a pool of 70 items. Each form contains three sets of 10 items. For instance, form 3 includes item 21 to item 30, then item 31 to 40 and finally 51 to 60. Each item appears one and only once with all the other 69 items and each item appears once in the three sets of items. This design allows 70 items instead of 30 items so that the domain is widely covered.

- Items should also be carefully selected according to their expected difficulty to cover the range of student abilities. Even if up-to-date scaling models and software packages can deal with floor effect or ceiling effect, it is still advisable to select items to avoid these effects.
- Finally, such assessment does not need definitively that the instruments be administered neither to all student nor to a sample of about 35 000 students. A sample of more or less 5000 students is quite large enough to provide accurate and precise estimations and furthermore presents the advantages to better secure the items that can be used for linking.

APPENDIXES

APPENDIX 1. TECHNICAL APPENDIXES

Scaling methods

The data were scaled according to an Item Response Theory model, in particular the Rasch model in a four-step process.

The two first steps were performed with the QUEST software package[4] and the last two steps were performed with CONQUEST[5]. The central element of both software packages is the RASCH Item Response Model. With this model, item difficulties and student abilities are estimated on a common scale.

It is not the purpose of this report to provide a detailed description of the Item Response Theory models used by QUEST and CONQUEST. One can consult the documentation accompanying the software packages or the psychometric literature. Only the central elements necessary to understand the information included in the report will be provided here.

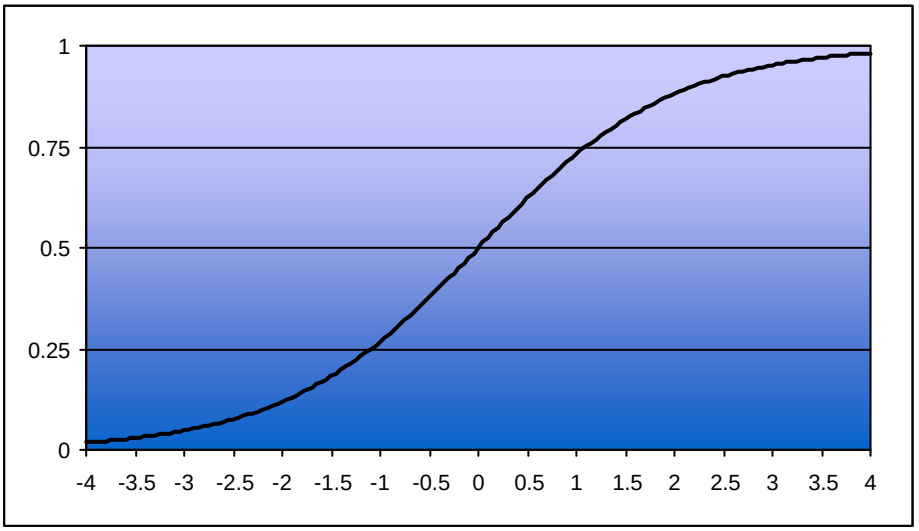
The Rasch model for dichotomous items

If the response of individual j to item i is indicated by the item score X_{ij} then the QUEST model for dichotomous data describes the probability of observing a score of 1 as:

$$P(X_{ij}=1)=\frac{\exp(\beta_i-\delta_j)}{1+\exp(\beta_i-\delta_j)}$$

This model is graphically represented in Figure 13. The X-axis represents the latent trait, i.e. the student ability (or β_i) and the Y-axis represents the probability to succeed a particular item of difficulty δ_i.

Figure 13: The Rasch Model



[4] ADAMS, R.J. & KHOO, S.T. (1996). ACER QUEST, The Interactive Test Analysis System. ACER Press.

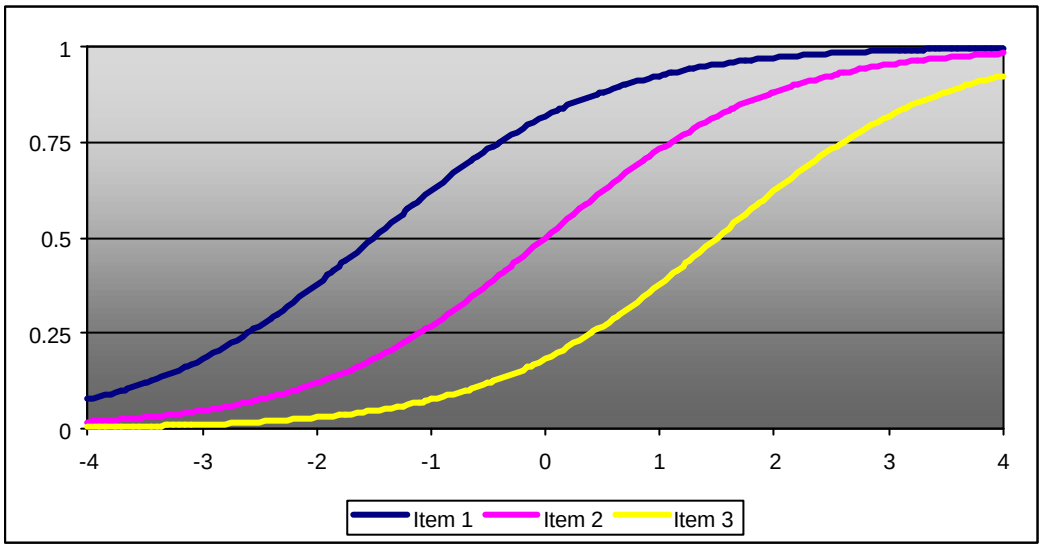
[5] WU, M.L., ADAMS, R.J., WILSON, M.R. (1998). ACER CONQUEST Generalised Item Response Modelling Software. ACER Press.

As shown by Figure 13, students with higher ability estimates on the latent trait have a higher probability to succeed the item of difficulty δ_I and this probability decreases as student ability estimates decreases.

For this dichotomous model, the item difficulty corresponds to the ability level for which students have exactly a probability of 0.5 of answering correctly. In this particular example, the item difficulty (δ_I) is equal to 0.

Figure 14 shows the probability curves of three items. In this particular case, δ_1 ,i.e. the item difficulty of item 1, is equal to –1.5, δ_2 is equal to 0 and δ_3 to 1.5. A student with an ability estimate of 0 has a probability of 0.81 to succeed item 1, of 0.5 to succeed item 2 and 0.19 to succeed item 3.

Figure 14: Probabilities of success for three items



As items and students are on the same scale the model needs a restriction to be performed. For these analyses, the average of the item difficulty estimates was set to 0.

Both QUEST and CONQUEST also provide information on the psychometric properties of the items. In addition to the classical item analysis and the well-known point-biserial correlation, both software packages provide a fit statistic which measures how well the data fit the probability curves as presented in Figure 14.

QUEST does not provide student estimates for students who do not correctly answer any items or correctly answer all items. Such students were encountered in the Argentine data, especially in grade 3 and in grade 5 were the tests seems to be too easy for some of the populations assessed. It was therefore necessary to use CONQUEST. CONQUEST has assembled in one software package the most up-to-date psychometric methods. One interesting component of CONQUEST for this particular project is his capability to provide unbiased estimates of the mean population even if cases where a substantial percentage of students have correctly answered all or no questions. But to produce this unbiased estimate on the mean, one have to assume that the population from which a sample was assessed is normally distributed. This assumption is, in most cases, unproblematic.

As the data were scaled by grade and by domain, the final scaling was done on more than one population. It was therefore necessary to add four dummy variables to enable CONQUEST to rebuilt the normal distribution for each school year population (see Appendix 2)

A four-step process

During the first step, each data file, i.e. the data of one grade in one domain for one school year were analysed independently of all other data. This step enables a straightforward computation of the psychometric characteristics of the different items.

Eight items (R3-325, M3-125, M5-402, M6-232, M6-413, R7-116, M7-204, M7-224) were dropped from the final scaling at this early stage because their psychometric coefficients were too far away from the usual standards. For instance, the point-biserial correlation coefficient of the correct answer was less than 0.20 and often another answer proposal has a point-biserial correlation higher than 0.10. Table 32 lists all items deleted from the final scaling due to poor psychometric properties.

Table 32: Deleted Items from the Conquest Scaling

Grade 3	*Grade 5*	*Grade 6*	*Grade 7*
R3-325	M5-402	M6-115	R7-116
M3-125		M6-123	M7-204
		M6-232	M7-224
		M6-413	

It is worth noting that all of these dropped items, except R3-325, M5-402, M6-115 were requested to be eliminated by the Ministry of Education in the item subset analyses.

During this step, a few incorrect keys (i.e. the numeric value of the correct answer) were identified.

The second step was designed to analyse the properties of the common items. Some items were not used as linking items because the keys changed from one school year to another one and some other items were not used because the change in the fit statistic was too important to consider them as anchor items. It should be noted that these items were not dropped from the final analysis but they were considered as non-common items. Table 34 to Table 43 lists the items used as anchoring items.

Step 1 and step 2 involve two scaling analyses per grade, per domain and per school year. It means that about 100 scalings with Quest were performed.

Step 3 was devoted to the file preparation according to the description provided in Appendix 2 and to the item calibration with CONQUEST. This latter task involves the selection of a student sample and the computation of the item difficulties. As CONQUEST needs several thousands of computations, it can take several hours on a huge file. As the sample size of the assessments conducted in Argentina were very large, it was necessary to draw a sample for the item calibration. Table 44 to Table 53 provides the CONQUEST item difficulty estimates per domain and per grade. For each grade and each domain, the sum of the item difficulty estimates is equal to 0.

Step four only implies the computation of the mean estimate and students estimates. As item parameters are centered on 0, the mean estimate of a population can be converted to an average expected probability. For instance, grade 3 mean of student Rasch estimates for the language test in 1996 is equal to 0.5707. The use for the Rasch formula for dichotomous item gives the average expected probability of success.

$$\overline{p} = \frac{\exp(\beta_i - \delta_j)}{1+\exp(\beta_i - \delta_j)} = \frac{\exp(0.5707 - 0)}{1+\exp(0.5705 - 0)} = 0.6389$$

It means that if the 1996 grade 3 students had responded all questions included in all 5 tests, one should expect to observe a average probability of success equal to 0.6389. It does not mean that the average percentage of correct answers of all 1996 students on the 1996 test only was equal to this value.

Step 3 and step 4 were repeated on the sub-sample of items.

Sampling variance estimation

According to the information provided to ACER, the sampling design used for the selection of the students is a stratified simple and random sampling of classes. The sample size within each stratum was proportional to the population sizes.

All students of the selected classes were assessed.

With a sampling cluster design for an infinite population, where level 1 represents the cluster level (i.e. the class level) and level 2 the unit level (i.e. the student), the sampling variance on the mean is equal to:

$$\sigma^2_{(\hat{u})} = \frac{\sigma^2_{level1}}{n_{level1}} + \frac{\sigma^2_{level2}}{n_{level1} n_{level2}}$$

In other words, the sampling variance on the mean is equal to the between-cluster variance divided by the number of cluster in the sample plus the within-cluster variance divided by the total number of students.
In the case of a finite population of equal cluster size, the sampling variance on the mean is equal to:

$$\sigma^2_{(\hat{u})} = (1 - f_1)\frac{\sigma^{*2}_{level1}}{n_{level1}} + f_1(1 - f_2)\frac{\sigma^2_{level2}}{n_{level1} n_{level2}}$$

$$\sigma^{*2}_{level1} = \sum_{i=1}^{n_{level1}} (\bar{y} - \bar{y}_i)^2 / (n_{level1} - 1)$$

$$f_1 = \frac{n_{level1}}{N_{level1}}; f_2 = \frac{n_{level2}}{N_{level2}}; \bar{y} = \frac{1}{n_{level1} n_{level2}} \sum_{i=1}^{n_{level1}} \sum_{j=1}^{n_{level2}} y_{ij}; \bar{y}_i = \frac{1}{n_{level2}} \sum_{j=1}^{n_{level2}} y_{ij}$$

As all students within a cluster were assessed, the term (1-f_2) is equal to 0 so that the residual variance or the within-cluster variance does not affect the sampling variance on the mean. Therefore, the second term of the right element of the equation disappears. The sampling becomes a simple and random sample of level 1 unit or a simple and random sample of classes.

Nevertheless, the class size variable presents a small variance and should therefore increase the sampling variance a little. On the other hand, the stratification variable and the sampling fraction should decrease the sampling variance. Due to the huge amount of data and due to the small stratum variance, it was decided to estimate the sampling variance on the mean by dividing the class variance by the number of classes assessed.

$$\sigma^2_{(\hat{u})} = \frac{\sigma^2_{level1}}{n_{level1}}$$

In the case of the census data, a simple and random sample of about 30 000 students was drawn from the population data. It was deemed unnecessary to compute the ability estimates for all students to provide a precise and unbiased estimate on the mean. In this case, the sampling variance estimate on the mean was computed as:

$$\sigma^2_{(\hat{u})} = \frac{\sigma^2}{n}$$

Sampling variances were not re-computed for the rescaling on a subset of items. To perform significance tests with the rescaled data, the sampling variance estimates from the previous analyses can be used directly.

Multiple comparison tables

One of the purposes of this report was to provide fair and accurate comparisons of student achievement across the different school years.

The test of equality of two means was performed as follow:

$$u_{obs} = \left|\bar{x}_1 - \bar{x}_2\right| / \sqrt{se_1^2 + se_2^2}$$

This method will provide biased probabilities if multiple comparisons are performed. For all statistical tests, there is a uncertainty, often labelled α or type I error. Type I error occurs when a true hypothesis is incorrectly rejected. In the case of a test of equality of means, the null hypothesis is the equality of the two means and therefore type I error is rejecting the equality of the means when they are equal. Researchers usually use a risk of 0.05 or 0.01. In other words, the risk of not making a type I error is 0.95 or 0.99.

Because the comparison of the means of three populations involves three tests: population 1 *versus* population 2, population 1 *versus* population 3 and population 2 *versus* population 3. And since these are independent tests, the probability of not making a type I error is equal to $(1-\alpha)(1-\alpha)(1-\alpha)$. With $\alpha = 0.05$, the overall probability of not making a type I error is only 0.873.

Dunn (1961)[6] developed a procedure to correct this bias which consists of dividing the significance level (α) by the number of comparisons and then looking up the appropriate quantile from the normal distribution.

The number of comparisons can be easily computed with:

$$C_n^x = \frac{n!}{x!(n-x)!}$$

With 5 school years, there are 10 possible comparisons. To find the appropriate critical value, associated with 10 multiple comparisons, we have to divide α=0.05 by 10. As each comparison is a two-way test, we still have to divide the results 0.005 by 2. The critical value corresponding to 0.0025 is 2.81.

The grade 3 and grade 6 multiple comparisons only involve 4 school years. The appropriate critical value for 6 comparisons is equal to 2.6383.

The difference will be considered as significant if the absolute difference between the two means is bigger than:

$$2.81\sqrt{se_1^2 + se_2^2}$$

In the case of 10 comparisons and

$$2.64\sqrt{se_1^2 + se_2^2}$$

In the case of 6 comparisons.

[6] Dunn, O.J. (1961). Multiple comparisons among means. *Journal of the American Statistical Association, 56, 52-64.*

APPENDIX 2: FILE PREPARATION

All the files were submitted to ACER in DBase III format. The data were manipulated using SPSS before being transferred in ASCII or text format, the required input file for QUEST and CONQUEST scaling software packages.

The data submitted presented different format for the student identification. The student identifications were standardised according to the format included in the 1999 files, i.e. a two-digit identification for the county, a six-digit identification for the class and a two-digit identification for the student. As the files were merged for the final scaling per domain and per grade, a two-digit identification for the school year was added before the county identification. Each student has therefore a unique twelve-digit string identification.

Items presenting insufficient psychometric properties were dropped from the files (see Table 32). Remaining items were then labelled according to:

- the domain – R for Language, M for Mathematics – ;
- the grade level – 3,5,6,7,9–;
- the school year and the item place in the quiz. Items for 95 were labelled from 1 to 45, items for 96 were labelled from 101 to 145, items for 97 were labelled from 201 to 245 and so on.

For instance, item R3-108 represents the eighth item of the language grade 3 test.

Anchoring items, which presented sufficient anchoring properties, were renamed to the label assigned to the item the first time it appears in one of the test. For example, R3-23 was also used as item 27 in 1996, item 30 in 1997, item 21 in 1998 and item 21 in 1999. Items R3-127, R3-230, R3-321 and R3-421 were therefore re-labelled R3-23.

Files were then merged by domain and by grade and four dummy variables were added at the end of the files to indicate the school years in the CONQUEST analyses. Table 33 shows the name of the four variables and the values assigned to the school year for each variable.

Table 33: Dummy variables as indicators of the school year.

School year	*X96*	*X97*	*X98*	*X99*
95	0	0	0	0
96	1	0	0	0
97	0	1	0	0
98	0	0	1	0
99	0	0	0	1

The next tables show the items, which were used as anchored items. Figure 15 shows the structure of the merged data files.

Table 34: Anchoring items in Language grade 3.

1995	*1996*	*1997*	*1998*	*1999*
	R3-102	R3-202	R3-301	R3-409
			R3-321	R3-410
	R3-105	R3-205	R3-303	R3-411
	R3-108	R3-208	R3-304	R3-412
	R3-109	R3-209	R3-305	R3-413
	R3-110	R3-210	R3-306	R3-414
	R3-113	R3-212	R3-307	R3-415
R3-9	R3-114	R3-213	R3-308	R3-416
			R3-324	R3-417
	R3-116	R3-215	R3-310	
			R3-328	R3-419
	R3-104	R3-204	R3-302	R3-422
	R3-115	R3-214	R3-309	R3-428
			R3-318	R3-431
			R3-320	R3-433

Table 35: Anchoring items in Mathematics grade 3.

1995	*1996*	*1997*	*1998*	*1999*
M3-5	M3-106	M3-206	M3-304	M3-403
	M3-109	M3-209	M3-305	M3-404
	M3-104	M3-204	M3-308	M3-409
	M3-110	M3-210	M3-312	M3-413
	M3-113	M3-213	M3-302	M3-416
	M3-121	M3-219	M3-313	M3-420

Table 36: Anchoring items in Language grade 5.

1995	*1996*	*1997*	*1998*	*1999*
R5-23	R5-127	R5-230	R5-321	R5-421
R5-16	R5-122	R5-225	R5-322	R5-422
R5-20	R5-125	R5-228		
R5-14	R5-121	R5-224	R5-324	R5-424
R5-24	R5-128	R5-231	R5-325	R5-425
R5-32	R5-135	R5-238	R5-326	R5-426
R5-33	R5-136	R5-239	R5-327	R5-427
R5-31	R5-134	R5-237	R5-328	R5-428
R5-29	R5-132	R5-235	R5-329	R5-429
R5-36	R5-137	R5-240	R5-333	R5-433
R5-39	R5-140	R5-243	R5-334	R5-434
R5-42	R5-143	R5-246	R5-337	R5-437
R5-44	R5-144	R5-247	R5-339	R5-439

Table 37: Anchoring items in Mathematics grade 5.

1995	*1996*	*1997*	*1998*	*1999*
	M5-107	M5-208	M5-302	M5-408
M5-2	M5-102	M5-207	M5-303	M5-409
	M5-112	M5-211	M5-306	M5-410
			M5-307	M5-411
	M5-119	M5-213		
	M5-124	M5-218	M5-314	M5-415
M5-20	M5-120	M5-219	M5-315	M5-413
M5-29	M5-129	M5-224		M5-421
M5-33	M5-133	M5-227	M5-327	
M5-41	M5-141		M5-330	
	M5-142	M5-233	M5-331	M5-428
	M5-143	M5-232		M5-427

Table 38: Anchoring items in Language grade 6.

1996	*1997*	*1998*	*1999*
	R6-227	R6-323	R6-427
	R6-208	R6-326	R6-422
	R6-212	R6-327	R6-424
	R6-218	R6-328	R6-423
	R6-221	R6-329	R6-425
R6-125	R6-225	R6-330	R6-429
R6-122	R6-229	R6-331	R6-426
R6-126	R6-231	R6-332	R6-431
R6-128	R6-232	R6-333	R6-432
R6-129	R6-234	R6-334	R6-433
R6-130	R6-235	R6-335	R6-435

Table 39: Anchoring items in Mathematics grade 6.

1996	*1997*	*1998*	*1998*
M6-101	M6-201	M6-301	M6-401
M6-104	M6-204	M6-302	M6-403
	M6-208	M6-304	M6-425
M6-112	M6-211	M6-305	M6-417
M6-117	M6-217	M6-306	M6-420
M6-119	M6-219	M6-307	M6-434
M6-121	M6-221	M6-308	M6-412
M6-127	M6-226	M6-309	M6-426
	M6-205	M6-303	M6-408

Table 40: Anchoring items in Language grade 7.

1995	*1996*	*1997*	*1998*	*1999*
R7-23	R7-124	R7-224		
	R7-125	R7-225	R7-321	R7-421
R7-26	R7-126			
R7-27	R7-127	R7-227	R7-322	R7-425
R7-28	R7-128	R7-228		
R7-29	R7-129	R7-229	R7-323	R7-426
R7-30	R7-130	R7-230	R7-324	R7-428
R7-31	R7-131	R7-231		
R7-32	R7-132	R7-232		
R7-33	R7-133	R7-233	R7-325	R7-429
R7-34	R7-134	R7-234		
R7-35	R7-135	R7-235		
R7-36	R7-136	R7-236		
	R7-137	R7-237	R7-327	R7-431
R7-38	R7-138	R7-238	R7-326	R7-430
R7-39	R7-139	R7-239		
R7-40	R7-140	R7-240		
R7-41	R7-141	R7-241	R7-328	R7-433
	R7-142	R7-242		
R7-43	R7-143	R7-243		
R7-44	R7-144	R7-244	R7-329	R7-434
	R7-145	R7-245	R7-330	R7-435

Table 41: Anchoring items in Mathematics grade 7.

1995	*1996*	*1997*	*1998*	*1999*
		M7-205	M7-305	M7-405
M7-8	M7-106	M7-206	M7-306	M7-406
M7-10	M7-108	M7-208	M7-308	M7-408
	M7-112		M7-312	
M7-19	M7-116	M7-216	M7-316	M7-416
	M7-120	M7-220	M7-320	M7-420
	M7-126		M7-329	M7-429
M7-31	M7-127	M7-227	M7-330	M7-430
M7-32	M7-128	M7-228	M7-331	M7-431
M7-43	M7-137	M7-237	M7-334	M7-434
M7-42	M7-138	M7-238	M7-336	
M7-36	M7-132	M7-232	M7-339	M7-439

Table 42: Anchoring items in Language grade 9.

R9-20	R9-123	R9-227	R9-325	R9-428
R9-21	R9-124	R9-223		
R9-24	R9-125	R9-225	R9-323	R9-426
R9-25	R9-126	R9-224	R9-322	R9-425
R9-26	R9-127	R9-226	R9-324	R9-427
R9-27	R9-128	R9-228	R9-328	R9-429
R9-28	R9-129	R9-229	R9-329	R9-430
R9-29	R9-130	R9-230	R9-330	R9-431
R9-30	R9-131	R9-231	R9-331	R9-432
R9-31	R9-132	R9-233	R9-333	R9-434
R9-32	R9-133	R9-232	R9-332	R9-433
R9-34	R9-135	R9-235	R9-334	R9-435
R9-37	R9-137	R9-237	R9-335	R9-436
R9-39	R9-139	R9-240	R9-337	R9-438
R9-41		R9-241	R9-338	R9-439
R9-42	R9-142	R9-242	R9-339	R9-440
R9-44	R9-144	R9-245		

Table 43: Anchoring items in Mathematics grade 9.

M9-10	M9-110	M9-210	M9-310	M9-411
M9-11	M9-111	M9-211	M9-311	M9-412
	M9-112	M9-212	M9-312	M9-413
M9-14	M9-114	M9-214	M9-313	M9-414
M9-15	M9-115	M9-215	M9-314	M9-415
	M9-116	M9-216		
M9-19		M9-222	M9-319	M9-421
	M9-130	M9-230	M9-324	M9-426
	M9-134	M9-234	M9-328	M9-431
M9-33	M9-133	M9-233	M9-331	M9-432
	M9-137	M9-237	M9-332	M9-434
	M9-139	M9-239	M9-333	M9-435
M9-40	M9-142	M9-242	M9-336	M9-440

Figure 15: Structure of the data files for Conquest analyses – Language grade 7.

```
95010000020221344343311422313211314344213433214342341324400000
95010000020421334343314432313342329244222412424134144342200000
95010000020531344343314232314331214144411413123333233224400000
95010000020721331313311432313332322144213143123324431123300000
95010000020833311124414244422241312334233213311133431424200000
95010000020923334223314232413232214344413413123123231424400000
95010000021223232224114231114343242134233123323112232344400000
95010000021324312214212231421241221144333232132112233121400000
95010000021423434323314213312421232143114131214241432143100000
961000281218                    3  24122141342 2432 33 12142144234223421311421334 1000
961000281219                    2  22433244332 2342 21 12141144234223123313244423 1000
961000281220                    4  11224312423 3142 12 14142211224213122244411124 1000
961000281221                    4  11224124112 2313 41 14142111324213122244411422 1000
961000281222                    4  24123232239 9922 31 12142144234223441322312914 1000
961000281223                    4  21231242312 2322 32 41241244233111422144312111 1000
961000281224                    1  22213222341 2212 12 21241244324223134211412233 1000
961000281225                    2  42244131133 3211 24 24241244231111331212192121 1000
961000281226                    2  42334423233 3231 34 22233123134142131432343322 1000
971701703725                    4   1312133333 2231 21                    21241242232312411161321912440100
971701703726                    1   1131133231 2211 24                    14431242211313311361321112210100
971701703727                    4   3133131213 2311 24                    12321111223231141211212143234 0100
971701704001                    3   2334132241 2213 24                    13333241211311412331122312310100
971701704002                    4   4334431231 2233 24                    21434242231341411331221312240100
971701704003                    4   2112221231 1132 11                    24443221231311211111221112210100
971701704004                    4   4131131211 2312 24                    21232142231311411131221122410100
971701704005                    4   4334431231 3211 24                    21434242231341411331221212240100
981400000629                        4 34  1    3  1  4                  21 3                        411121412221342132131221400010
981400000630                        4 31  1    3  1  4                  21 3                        441121412221342132131221400010
981400000901                        4 34  1    3  1  4                  22 1                        411121412221342134132221400010
981400000902                        4 31  1    2  4  4                  21 3                        414124411221342431131222400010
981400000903                        4 43  2    3  3  4                  23 4                        411232344222333432131221400010
981400000905                        4 34  1    3  4  4                  21 3                        411121112221342132131111400010
981400000908                        2 92  1    1  1  4                  43 2                        321141232321441332323224400010
981400000909                        2 12  1    2  1  4                  32 3                        411141113142242111233131400010
991515439428                        3 24  1    3  2  1                  22 3                                                    233133431323241312144141300010
991515439429                        3 34  4    1  2  1                  22 3                                                    424134494241341414413932400010
991515439430                        3 42  1    1  4  1                  23 2                                                    233434331423241914331432200010
991515439431                        2 44  3    3  2  4                  32 2                                                    413133332223222423413212400010
991515439701                        2 22  1    2  2  4                  12 2                                                    233134331221241231223124400010
991515439702                        4 34  1    2  1  4                  23 3                                                    243234331344343344443212400010
991515439703                        4 41  1    3  1  4                  21 4                                                    234432333222321231343412400010
991515439704                        9 34  1    3  4  3                  23 3                                                    243234331344343344443412900010
991515439705                        4 23  1    3  1  4                  12 2                                                    244314234133322243243234300010
```

APPENDIX 3: ITEM PARAMETER ESTIMATES

Table 44: Item parameters - Grade 3 Language

R3-1	-0.963
R3-2	-0.357
R3-3	-0.059
R3-4	0.052
R3-5	0.803
R3-6	0.128
R3-7	-0.146
R3-8	0.566
R3-9	-0.080
R3-10	0.155
R3-11	1.000
R3-12	0.398
R3-13	0.485
R3-14	1.237
R3-15	0.262
R3-16	-0.230
R3-17	-0.377
R3-18	-1.481
R3-19	-1.081
R3-20	-1.429
R3-21	-0.518
R3-22	-0.433
R3-23	-0.655
R3-24	1.061
R3-25	0.875
R3-101	0.095
R3-102	0.025
R3-103	-0.716
R3-104	-0.556
R3-105	0.301
R3-106	0.797
R3-107	0.900
R3-108	0.450
R3-109	0.434
R3-110	-0.557
R3-111	-1.363
R3-112	0.278
R3-113	0.308
R3-115	0.231
R3-116	-0.208
R3-117	1.454
R3-118	-0.723
R3-119	-0.581
R3-120	-0.313
R3-121	-1.775
R3-122	-1.240
R3-123	-1.094
R3-124	-0.669
R3-125	1.351
R3-126	-0.614
R3-127	-0.950
R3-128	-0.670
R3-129	-0.792
R3-130	0.790
R3-131	0.106
R3-132	1.965
R3-201	0.204
R3-203	-0.824
R3-206	0.743
R3-207	0.890
R3-211	0.419
R3-216	1.391
R3-217	-0.707
R3-218	0.447
R3-219	-0.335
R3-220	-0.269
R3-221	0.271
R3-222	-0.397
R3-223	-0.533
R3-224	-0.461
R3-225	-0.110
R3-226	-1.791
R3-227	0.800
R3-228	0.331
R3-229	-1.123
R3-230	-0.720
R3-231	0.997
R3-232	0.340
R3-233	-1.318
R3-234	0.595
R3-235	0.476
R3-236	0.540
R3-237	-0.960
R3-238	0.847
R3-239	1.256
R3-240	1.036
R3-241	0.656
R3-242	0.675
R3-311	-0.804
R3-312	-0.131
R3-313	1.020
R3-314	0.662
R3-315	-0.855
R3-316	0.470
R3-317	1.036
R3-318	0.043
R3-319	0.882
R3-320	-0.626
R3-321	-1.093
R3-322	0.246
R3-323	-0.297
R3-324	-0.817
R3-326	-0.698
R3-327	-0.050
R3-328	0.364
R3-329	-0.248
R3-330	0.133
R3-401	0.838
R3-402	0.483
R3-403	0.143
R3-404	0.392
R3-405	-0.576
R3-406	0.464
R3-407	0.099
R3-408	0.749
R3-418	0.108
R3-420	-0.233
R3-421	-0.009
R3-423	0.668
R3-424	-0.319
R3-425	-0.636
R3-426	-0.466
R3-427	-0.386
R3-429	-0.311
R3-430	-0.182
R3-432	0.695

Table 45: Item parameters - Grade 3 Mathematics

M3-1	-0.172
M3-2	-0.753
M3-3	-0.953
M3-4	-1.072
M3-5	0.508
M3-6	0.774
M3-7	0.685
M3-8	-0.156
M3-9	-1.346
M3-10	1.449
M3-11	-0.489
M3-12	-0.371
M3-13	-1.213
M3-14	-0.977
M3-15	1.212
M3-16	0.005
M3-17	0.671
M3-18	0.528
M3-19	-0.502
M3-20	0.350
M3-21	0.173
M3-22	0.813
M3-23	-0.523
M3-24	-1.047
M3-25	-0.590
M3-101	-1.952
M3-102	-0.460
M3-103	-0.126
M3-104	0.318
M3-105	-0.848
M3-107	-1.351
M3-108	0.037
M3-109	0.402
M3-110	0.222
M3-111	-0.619
M3-112	1.162
M3-113	-1.133
M3-114	-1.472
M3-115	1.411
M3-116	1.088
M3-117	-0.931

M3-118	0.311
M3-119	0.422
M3-120	-0.972
M3-121	1.197
M3-122	1.773
M3-123	2.296
M3-124	1.194
M3-201	-2.031
M3-202	-0.424
M3-203	-0.561
M3-205	-0.681
M3-207	0.810
M3-208	0.336
M3-211	1.451
M3-212	1.029
M3-214	-1.008
M3-215	1.890
M3-216	0.809
M3-217	0.171
M3-218	0.520
M3-220	0.428
M3-221	0.898
M3-222	0.848
M3-223	0.350
M3-224	1.150
M3-225	1.893
M3-226	0.055
M3-227	1.835
M3-228	0.697
M3-229	1.352
M3-230	0.997
M3-301	-1.155
M3-303	-1.172
M3-306	-1.351
M3-307	0.022
M3-309	-0.652
M3-310	-0.175
M3-311	-0.248
M3-314	-0.789
M3-315	-0.006
M3-316	-0.642

M3-317	0.289
M3-318	0.690
M3-319	-0.320
M3-320	0.257
M3-321	-1.037
M3-322	-0.721
M3-323	0.063
M3-324	0.675
M3-325	0.108
M3-326	0.421
M3-327	0.491
M3-328	0.620
M3-329	-0.390
M3-330	0.855
M3-401	-1.308
M3-402	-1.191
M3-405	0.211
M3-406	-0.015
M3-407	-0.044
M3-408	-0.777
M3-410	-0.196
M3-411	-0.029
M3-412	-1.136
M3-414	-0.805
M3-415	0.096
M3-417	0.747
M3-418	-0.347
M3-419	0.648
M3-421	0.820
M3-422	-1.118
M3-423	-1.114
M3-424	-0.429
M3-425	-0.055
M3-426	-0.022
M3-427	-0.498
M3-428	-0.807
M3-429	-0.647
M3-430	0.392

Table 46: Item parameters - Grade 5 Language

R5-1	-1.088
R5-2	0.070
R5-3	-0.560
R5-4	-0.859
R5-5	0.395
R5-6	-1.045
R5-7	-0.668
R5-8	-0.357
R5-9	0.126
R5-10	-0.522
R5-11	-1.359
R5-12	-0.276
R5-13	-0.398
R5-14	-0.548
R5-15	-1.415
R5-16	1.184
R5-17	0.170
R5-18	-2.254
R5-19	-0.172
R5-20	-0.443
R5-21	-0.177
R5-22	-0.951
R5-23	-0.074
R5-24	0.320
R5-25	-1.410
R5-26	0.995
R5-27	0.499
R5-28	-0.295
R5-29	-0.783
R5-30	0.348
R5-31	-0.040
R5-32	-0.253
R5-33	0.167
R5-34	-1.524
R5-35	-0.537
R5-36	0.115
R5-37	0.430
R5-38	0.067
R5-39	-0.725
R5-40	1.009
R5-41	0.924
R5-42	0.221
R5-43	-0.260
R5-44	-0.048
R5-45	-1.490
R5-101	0.211
R5-102	-0.250
R5-103	-0.249
R5-104	-0.176
R5-105	0.075
R5-106	1.276
R5-107	-0.361
R5-108	-0.203
R5-109	1.076
R5-110	1.051
R5-111	-0.500
R5-112	-0.912
R5-113	0.544
R5-114	-0.325
R5-115	0.151
R5-116	-1.022
R5-117	-0.850
R5-118	-1.334
R5-119	-0.684
R5-120	-0.205
R5-123	0.269
R5-124	-0.134
R5-126	-0.169
R5-129	0.776
R5-130	0.602
R5-131	-0.171
R5-133	0.060
R5-138	0.306
R5-139	-0.056
R5-141	0.953
R5-142	0.792
R5-145	0.504
R5-201	-0.818
R5-202	0.176
R5-203	-1.340
R5-204	-1.361
R5-205	-0.571
R5-206	-0.745
R5-207	0.527
R5-208	0.988
R5-209	0.005
R5-210	-0.998
R5-211	0.103
R5-212	0.047
R5-213	-0.522
R5-214	-0.118
R5-215	0.925
R5-216	0.137
R5-217	0.001
R5-218	-0.301
R5-219	-0.815
R5-220	-0.734
R5-221	-0.869
R5-222	-0.251
R5-223	1.442
R5-226	0.428
R5-227	-0.062
R5-229	0.259
R5-232	1.233
R5-233	0.695
R5-234	-0.120
R5-236	0.273
R5-241	0.417
R5-242	0.276
R5-244	1.074
R5-245	1.116
R5-248	0.707
R5-301	-0.662
R5-302	0.751
R5-303	0.934
R5-304	0.163
R5-305	-0.628
R5-306	0.455
R5-307	-0.279
R5-308	-0.036
R5-309	0.509
R5-310	0.675
R5-311	0.355
R5-312	-0.546
R5-313	-0.496
R5-314	-1.017
R5-315	-0.177
R5-316	0.584
R5-317	0.327
R5-318	-0.331
R5-319	0.034
R5-320	0.219
R5-323	0.023
R5-330	-0.432
R5-331	-0.404
R5-332	-0.362
R5-335	-0.200
R5-336	0.125
R5-338	1.349
R5-340	-0.602
R5-401	0.385
R5-402	1.401
R5-403	0.193
R5-404	0.404
R5-405	0.979
R5-406	0.680
R5-407	0.018
R5-408	-0.012
R5-409	0.730
R5-410	1.258
R5-411	0.416
R5-412	-0.119
R5-413	-0.418
R5-414	-0.436
R5-415	-0.531
R5-416	0.192
R5-417	0.197
R5-418	1.004
R5-419	0.020
R5-420	0.750
R5-423	0.011
R5-430	-0.502
R5-431	0.626
R5-432	0.549
R5-435	0.668
R5-436	0.758
R5-438	1.564
R5-440	0.127*

Table 47: Item parameters - Grade 5 Mathematics

M5-1	1.140
M5-2	-0.120
M5-3	-0.282
M5-4	-0.276
M5-5	-0.093
M5-6	-0.053
M5-7	-1.653
M5-8	-1.099
M5-9	1.254
M5-10	0.352
M5-11	0.216
M5-12	-0.115
M5-13	-0.073
M5-14	0.811
M5-15	1.173
M5-16	0.431
M5-17	-0.385
M5-18	0.367
M5-19	-0.016
M5-20	-0.113
M5-21	0.433
M5-22	1.441
M5-23	0.095
M5-24	-0.551
M5-25	0.753
M5-26	0.509
M5-27	0.224
M5-28	0.068
M5-29	-0.768
M5-30	-1.199
M5-31	0.855
M5-32	-0.223
M5-33	0.056
M5-34	0.666
M5-35	0.014
M5-36	0.503
M5-37	0.900
M5-38	0.349
M5-39	0.271
M5-40	0.417
M5-41	-0.008
M5-42	-0.134
M5-43	0.306
M5-44	0.051
M5-45	0.263
M5-101	0.227
M5-103	-0.076
M5-104	-0.300
M5-105	-0.123
M5-106	0.028
M5-107	-0.794
M5-108	-1.242
M5-109	0.578
M5-110	-0.134
M5-111	0.288
M5-112	-0.306
M5-113	-0.078
M5-114	-0.755
M5-115	-1.072
M5-116	0.314
M5-117	-0.369
M5-118	-1.181
M5-119	-0.907
M5-121	0.428
M5-122	1.427
M5-123	-0.089
M5-124	-0.634
M5-125	0.626
M5-126	0.488
M5-127	-0.013
M5-128	-0.088
M5-130	0.161
M5-131	0.902
M5-132	-0.377
M5-134	0.793
M5-135	0.033
M5-136	0.470
M5-137	1.011
M5-138	0.391
M5-139	0.199
M5-140	0.209
M5-142	-0.641
M5-143	-0.030
M5-144	0.207
M5-145	0.348
M5-201	-1.092
M5-202	-0.196
M5-203	-0.838
M5-204	0.775
M5-205	-0.159
M5-206	0.209
M5-209	0.251
M5-210	-0.862
M5-212	-1.061
M5-214	0.810
M5-215	0.185
M5-216	1.142
M5-217	0.225
M5-220	-0.412
M5-221	-0.675
M5-222	0.296
M5-223	0.693
M5-225	-2.671
M5-226	0.181
M5-228	0.783
M5-229	0.623
M5-230	-1.259
M5-231	-0.337
M5-234	0.268
M5-235	-0.058
M5-236	0.856
M5-237	1.022
M5-238	1.502
M5-239	-1.088
M5-240	-0.744
M5-241	0.609
M5-242	-0.764
M5-243	-1.216
M5-301	0.493
M5-304	-0.470
M5-305	0.998
M5-308	-0.616
M5-309	-1.175
M5-310	-1.349
M5-311	-0.045
M5-312	0.095
M5-313	0.372
M5-316	-0.215
M5-317	-0.038
M5-318	-0.853
M5-319	-0.532
M5-320	-0.046
M5-321	0.470
M5-322	-1.109
M5-323	-0.375
M5-324	0.624
M5-325	0.681
M5-326	-0.479
M5-328	-0.396
M5-329	-0.955
M5-332	1.501
M5-333	-1.122
M5-334	-0.251
M5-335	0.047
M5-336	0.732
M5-337	-1.326
M5-338	-0.343
M5-339	-0.344
M5-340	-0.034
M5-401	0.175
M5-403	1.232
M5-404	0.544
M5-405	-0.419
M5-406	-0.399
M5-407	0.965
M5-412	-0.534
M5-414	-0.520
M5-416	-1.237
M5-417	-0.196
M5-418	-0.739
M5-419	0.732
M5-420	1.416
M5-422	0.294
M5-423	0.434
M5-424	0.485
M5-425	-0.353
M5-426	0.751
M5-429	-0.393
M5-430	0.080
M5-431	1.230
M5-432	0.291
M5-433	0.392
M5-434	-0.231
M5-435	0.887
M5-436	-0.069
M5-437	-1.557
M5-438	-1.242
M5-439	-0.527
M5-440	0.896*

Table 48: Item parameters - Grade 6 Language.

R6-101	-0.304
R6-102	1.040
R6-103	-0.777
R6-104	-0.431
R6-105	0.942
R6-106	0.019
R6-107	0.985
R6-108	0.018
R6-109	-0.234
R6-110	-0.264
R6-111	-0.232
R6-112	0.073
R6-113	0.650
R6-114	1.332
R6-115	0.758
R6-116	1.604
R6-117	-0.398
R6-118	0.164
R6-119	-0.124
R6-120	1.264
R6-121	0.213
R6-122	-0.261
R6-123	1.443
R6-124	-0.692
R6-125	-0.154
R6-126	0.321
R6-127	-0.389
R6-128	0.404
R6-129	-0.831
R6-130	-0.636
R6-201	-0.532
R6-202	0.608
R6-203	0.916
R6-204	-0.455
R6-205	0.236
R6-206	-0.264
R6-207	-0.086

R6-208	-0.287
R6-209	-2.063
R6-210	-1.063
R6-211	0.897
R6-212	-0.468
R6-213	-0.360
R6-214	0.531
R6-215	0.227
R6-216	0.704
R6-217	1.068
R6-218	-0.040
R6-219	1.040
R6-220	-0.326
R6-221	0.937
R6-222	0.752
R6-223	0.974
R6-224	-0.888
R6-226	-0.380
R6-227	-1.072
R6-228	0.640
R6-230	-0.913
R6-233	-0.606
R6-301	-1.309
R6-302	-0.657
R6-303	-0.172
R6-304	-0.249
R6-305	0.066
R6-306	-0.443
R6-307	-0.768
R6-308	-0.337
R6-309	0.712
R6-310	-0.386
R6-311	1.225
R6-312	0.987
R6-313	0.412
R6-314	0.070
R6-315	-0.547

R6-316	-1.111
R6-317	0.164
R6-318	0.953
R6-319	0.440
R6-320	0.741
R6-321	-1.378
R6-322	-1.467
R6-324	-1.512
R6-325	-0.801
R6-327	0.264
R6-401	-0.015
R6-402	0.874
R6-403	0.698
R6-404	0.347
R6-405	0.290
R6-406	0.319
R6-407	0.929
R6-408	0.029
R6-409	0.642
R6-410	0.485
R6-411	-1.327
R6-412	-0.198
R6-413	0.208
R6-414	-0.436
R6-415	-0.311
R6-416	-0.442
R6-417	0.150
R6-418	-0.390
R6-419	0.566
R6-420	-0.022
R6-421	-0.349
R6-424	0.071
R6-428	-1.101
R6-430	-0.634
R6-434	-0.508

Table 49: Item parameters - Grade 6 Mathematics

M6-101	-0.443
M6-102	1.631
M6-103	-1.472
M6-104	0.598
M6-105	1.166
M6-106	1.822
M6-107	0.211
M6-108	1.076
M6-109	-0.020
M6-110	-0.605
M6-111	0.772
M6-112	0.673
M6-113	0.658
M6-114	1.761
M6-116	-0.827
M6-117	0.012
M6-118	1.388
M6-119	-0.003
M6-120	0.836
M6-121	0.143
M6-122	-0.612
M6-124	0.744
M6-125	0.300
M6-126	0.441
M6-127	-0.183
M6-128	0.843
M6-129	1.931
M6-130	-0.219
M6-131	1.001
M6-132	1.219
M6-133	1.656
M6-134	1.221
M6-135	-1.162
M6-202	1.385
M6-203	-1.561
M6-205	-0.221
M6-206	1.191
M6-207	0.220
M6-208	-0.101
M6-209	-0.828
M6-210	-0.102
M6-212	-0.946
M6-213	-1.688
M6-214	0.687
M6-215	1.752
M6-216	-0.983
M6-218	1.392
M6-220	0.537
M6-222	-0.749
M6-223	0.493
M6-224	0.347
M6-225	0.237
M6-227	0.600
M6-228	1.597
M6-229	-1.093
M6-230	-0.451
M6-231	0.957
M6-233	1.336
M6-234	-0.712
M6-235	0.225
M6-236	-0.626
M6-237	0.073
M6-238	1.226
M6-239	1.120
M6-240	0.060
M6-310	-0.195
M6-311	-1.564
M6-312	-1.523
M6-313	0.223
M6-314	-1.114
M6-315	-1.036
M6-316	1.276
M6-317	-0.511
M6-318	-1.981
M6-319	-0.884
M6-320	-0.327
M6-321	-0.853
M6-322	-0.737
M6-323	-1.040
M6-324	-0.654
M6-325	0.102
M6-326	-0.974
M6-327	0.640
M6-328	-0.354
M6-329	0.717
M6-330	0.471
M6-331	-0.362
M6-332	0.370
M6-333	-0.167
M6-334	-0.327
M6-335	-0.165
M6-402	-0.081
M6-404	-1.458
M6-405	-0.308
M6-406	-1.492
M6-407	-1.129
M6-409	-1.390
M6-410	-1.210
M6-411	-0.754
M6-414	-1.728
M6-415	-1.021
M6-416	-2.252
M6-418	-1.242
M6-419	0.091
M6-421	1.893
M6-422	-0.408
M6-423	-0.408
M6-424	-0.760
M6-427	-0.506
M6-428	-0.911
M6-429	1.559
M6-430	1.179
M6-431	-0.634
M6-432	1.539
M6-433	0.680
M6-435	-0.212

Table 50: Item parameters - Grade 7 Language

R7-1	0.135
R7-2	0.887
R7-3	-1.034
R7-4	1.074
R7-5	-0.150
R7-6	-0.634
R7-7	-0.109
R7-8	-0.971
R7-9	-1.191
R7-10	-0.498
R7-11	0.944
R7-12	-0.997
R7-13	0.632
R7-14	0.022
R7-15	-0.475
R7-16	0.639
R7-17	0.994
R7-18	0.684
R7-19	0.826
R7-20	0.789
R7-21	-0.043
R7-22	0.921
R7-23	-0.147
R7-24	-0.280
R7-25	-0.562
R7-26	-0.455
R7-27	0.402
R7-28	0.759
R7-29	-0.416
R7-30	-0.148
R7-31	-0.126
R7-32	-0.381
R7-33	0.390
R7-34	-0.002
R7-35	0.042
R7-36	-0.062
R7-37	1.211
R7-38	0.183
R7-39	0.270
R7-40	0.085
R7-41	-0.096
R7-42	0.954
R7-43	-0.459
R7-44	0.120
R7-45	1.301
R7-101	-0.149
R7-102	0.225
R7-103	1.070
R7-104	0.894
R7-105	-0.542
R7-106	-0.372
R7-107	-0.828
R7-108	-0.068
R7-109	-0.410
R7-110	0.224
R7-111	-0.552
R7-112	0.533
R7-113	-0.437
R7-114	0.361
R7-115	0.193
R7-117	0.871
R7-118	-0.433
R7-119	0.838
R7-120	0.268
R7-121	0.541
R7-122	0.566
R7-123	0.498
R7-125	0.435
R7-137	1.181
R7-142	0.721
R7-145	0.238
R7-201	-0.437
R7-202	1.093
R7-203	0.569
R7-204	0.048
R7-205	-0.395
R7-206	-1.097
R7-207	0.213
R7-208	-1.180
R7-209	-0.284
R7-210	1.164
R7-211	0.668
R7-212	-0.991
R7-213	0.666
R7-214	0.032
R7-215	0.116
R7-216	-0.121
R7-217	-0.518
R7-218	-0.480
R7-219	-0.067
R7-220	0.478
R7-221	0.734
R7-222	-0.806
R7-223	1.106
R7-226	0.057
R7-301	-0.130
R7-302	0.597
R7-303	0.362
R7-304	0.580
R7-305	0.269
R7-306	0.401
R7-307	0.640
R7-308	-0.352
R7-309	-0.844
R7-310	-0.342
R7-311	-1.032
R7-312	-1.286
R7-313	-0.099
R7-314	-0.739
R7-315	-0.621
R7-316	-0.486
R7-317	-0.263
R7-318	-0.735
R7-319	0.224
R7-320	-0.259
R7-331	-0.875
R7-332	-1.062
R7-333	-0.865
R7-334	-0.361
R7-335	-1.050
R7-401	0.113
R7-402	-0.676
R7-403	0.850
R7-404	-0.341
R7-405	-0.820
R7-406	-0.341
R7-407	-0.703
R7-408	-1.112
R7-409	-0.300
R7-410	1.164
R7-411	-0.889
R7-412	0.630
R7-413	-0.162
R7-414	-0.412
R7-415	-0.722
R7-416	0.775
R7-417	0.837
R7-418	0.492
R7-419	-0.500
R7-420	0.472
R7-422	-1.384
R7-423	-0.084
R7-424	-0.059
R7-427	-0.514
R7-432	0.548

Table 51: Item parameters - Grade 7 Mathematics

M7-1	-1.064
M7-2	-1.125
M7-3	-1.888
M7-4	-1.930
M7-5	-0.796
M7-6	-0.776
M7-7	-0.879
M7-8	-0.070
M7-9	-0.551
M7-10	0.209
M7-11	-0.509
M7-12	-1.889
M7-13	-0.866
M7-14	0.616
M7-15	0.340
M7-16	-0.412
M7-17	0.226
M7-18	-0.226
M7-19	-0.310
M7-20	0.441
M7-21	0.403
M7-22	0.126
M7-23	-0.311
M7-24	-0.023
M7-25	0.033
M7-26	0.181
M7-27	0.422
M7-28	0.448
M7-29	-0.136
M7-30	0.030
M7-31	-0.807
M7-32	0.260
M7-33	0.583
M7-34	0.240
M7-35	0.046
M7-36	0.854
M7-37	1.146
M7-38	0.567
M7-39	0.142
M7-40	0.934
M7-41	0.317
M7-42	-0.682
M7-43	-0.306
M7-44	0.254
M7-45	0.021
M7-101	-0.936
M7-102	-1.408
M7-103	-0.323
M7-104	-0.645
M7-105	0.371
M7-107	-0.316
M7-109	-0.271
M7-110	-0.799
M7-111	1.215
M7-112	-0.802
M7-113	-0.574
M7-114	0.333
M7-115	-0.019
M7-117	0.192
M7-118	1.443
M7-119	0.449
M7-120	-0.671
M7-121	0.338
M7-122	1.398
M7-123	-1.540
M7-124	0.734
M7-125	-0.132
M7-126	0.690
M7-129	0.718
M7-130	0.197
M7-131	-0.003
M7-133	0.689
M7-134	0.189
M7-135	1.123
M7-136	0.472
M7-139	-0.038
M7-140	0.233
M7-141	1.842
M7-142	2.384
M7-143	2.512
M7-144	0.857
M7-145	1.920
M7-201	-0.066
M7-202	-1.062
M7-203	-0.057
M7-205	0.312
M7-207	-0.897
M7-209	-0.694
M7-210	-0.359
M7-211	0.255
M7-212	-0.505
M7-213	0.512
M7-214	0.458
M7-215	0.414
M7-217	0.355
M7-218	1.174
M7-219	0.412
M7-221	0.752
M7-222	0.231
M7-223	0.385
M7-225	0.698
M7-226	0.879
M7-229	0.841
M7-230	0.134
M7-231	0.360
M7-233	0.878
M7-234	0.421
M7-235	0.979
M7-236	0.369
M7-239	0.244
M7-240	0.776
M7-301	-0.750
M7-302	-1.201
M7-303	-0.692
M7-304	-0.277
M7-307	-0.085
M7-309	2.007
M7-310	-0.664
M7-311	-0.479
M7-313	-0.933
M7-314	0.393
M7-315	-0.473
M7-317	-0.479
M7-318	0.501
M7-319	-0.809
M7-321	-0.879
M7-322	-1.374
M7-323	-0.187
M7-324	0.241
M7-325	0.387
M7-326	0.572
M7-327	-1.177
M7-328	-0.195
M7-332	0.020
M7-333	-0.533
M7-335	-0.134
M7-337	0.652
M7-338	0.048
M7-340	0.250
M7-401	-0.057
M7-402	-0.079
M7-403	-2.197
M7-404	-0.589
M7-407	0.285
M7-409	-1.472
M7-410	-1.251
M7-411	0.461
M7-412	-1.483
M7-413	-0.498
M7-414	0.550
M7-415	-0.225
M7-417	-0.961
M7-418	1.274
M7-419	0.209
M7-421	0.124
M7-422	-0.072
M7-423	-1.376
M7-424	-0.134
M7-425	-0.686
M7-426	0.358
M7-427	-0.282
M7-428	0.802
M7-432	-0.349
M7-433	-0.666
M7-435	-0.579
M7-436	-0.121
M7-437	0.458
M7-438	0.331
M7-440	1.169

Table 52: Item parameters – Grade 9 Language

R9-1	0.181
R9-2	0.199
R9-3	-0.786
R9-4	-1.357
R9-5	1.848
R9-6	0.713
R9-7	0.855
R9-8	0.555
R9-9	-0.728
R9-10	0.331
R9-11	1.419
R9-12	0.048
R9-13	0.288
R9-14	0.347
R9-15	0.039
R9-16	0.658
R9-17	0.089
R9-18	0.242
R9-19	0.119
R9-20	0.001
R9-21	-0.176
R9-22	-0.619
R9-23	-0.383
R9-24	0.417
R9-25	-0.568
R9-26	0.225
R9-27	0.466
R9-28	0.071
R9-29	0.665
R9-30	-0.416
R9-31	0.107
R9-32	-0.139
R9-33	-0.310
R9-34	0.545
R9-35	-0.088
R9-36	1.294
R9-37	0.178
R9-38	-0.278
R9-39	0.311
R9-40	-0.760
R9-41	-0.132
R9-42	-0.023
R9-43	0.680
R9-44	-0.127
R9-45	0.528
R9-101	-0.876
R9-102	0.206
R9-103	-1.030
R9-104	-0.366
R9-105	0.181
R9-106	0.792
R9-107	-0.978
R9-108	-0.907
R9-109	-0.513
R9-110	-0.928
R9-111	-0.515
R9-112	-0.879
R9-113	-0.016
R9-114	-0.659
R9-115	0.742
R9-116	-0.167
R9-117	0.577
R9-118	0.416
R9-119	0.456
R9-120	-0.286
R9-121	-0.369
R9-122	-0.139
R9-134	1.594
R9-136	1.150
R9-138	0.014
R9-140	0.284
R9-141	-0.433
R9-143	0.589
R9-145	0.470
R9-201	-0.300
R9-202	-0.425
R9-203	0.865
R9-204	0.564
R9-205	-0.669
R9-206	-1.062
R9-207	0.058
R9-208	-1.876
R9-209	-0.187
R9-210	-0.855
R9-211	-0.324
R9-212	0.398
R9-213	-0.586
R9-214	0.314
R9-215	0.263
R9-216	0.674
R9-217	0.253
R9-218	1.044
R9-219	0.576
R9-220	-0.693
R9-221	-0.444
R9-222	0.873
R9-234	0.297
R9-236	0.842
R9-238	-0.007
R9-239	0.078
R9-243	0.543
R9-244	0.704
R9-301	0.593
R9-302	0.976
R9-303	0.404
R9-304	-0.919
R9-305	0.603
R9-306	-1.147
R9-307	-1.606
R9-308	0.610
R9-309	0.063
R9-310	-1.216
R9-311	-1.151
R9-312	0.615
R9-313	-0.006
R9-314	0.276
R9-315	-0.858
R9-316	-0.496
R9-317	0.104
R9-318	-0.767
R9-319	0.124
R9-320	0.728
R9-321	0.692
R9-326	-0.433
R9-327	-0.871
R9-336	-0.095
R9-340	-0.073
R9-401	-0.256
R9-402	0.735
R9-403	-0.475
R9-404	-0.403
R9-405	0.387
R9-406	-1.025
R9-407	0.312
R9-408	-0.926
R9-409	-0.365
R9-410	0.257
R9-411	0.658
R9-412	0.693
R9-413	-0.132
R9-414	-0.654
R9-415	1.200
R9-416	0.991
R9-417	0.382
R9-418	-0.025
R9-419	0.062
R9-420	-0.022
R9-421	-0.637
R9-422	-0.593
R9-423	-0.568
R9-424	-1.576
R9-437	-0.025

Table 53: Item parameters – Grade 9 Mathematics

M9-1	0.467
M9-2	0.474
M9-3	0.070
M9-4	0.893
M9-5	0.182
M9-6	0.831
M9-7	0.729
M9-8	1.235
M9-9	0.668
M9-10	-0.427
M9-11	0.117
M9-12	0.765
M9-13	0.666
M9-14	-0.372
M9-15	-0.010
M9-16	1.200
M9-17	0.285
M9-18	1.401
M9-19	0.169
M9-20	0.228
M9-21	1.382
M9-22	-0.866
M9-23	0.441
M9-24	0.484
M9-25	0.498
M9-26	-0.021
M9-27	0.260
M9-28	0.108
M9-29	1.047
M9-30	-1.114
M9-31	-0.029
M9-32	0.993
M9-33	0.155
M9-34	0.887
M9-35	1.155
M9-36	0.954
M9-37	0.591
M9-38	1.250
M9-39	0.666
M9-40	-0.764
M9-41	0.330
M9-42	-0.440
M9-43	-0.871
M9-44	0.779
M9-45	0.454
M9-101	0.453
M9-102	0.558
M9-103	-0.859
M9-104	0.569
M9-105	0.121
M9-106	1.078
M9-107	0.696
M9-108	0.115
M9-109	-0.385
M9-112	-0.658
M9-113	1.151
M9-116	-0.742
M9-117	0.801
M9-118	0.631
M9-119	-1.460
M9-120	1.178
M9-121	-0.096
M9-122	-1.671
M9-123	-1.182
M9-124	-0.037
M9-125	-0.799
M9-126	0.742
M9-127	0.406
M9-128	0.258
M9-129	-0.018
M9-130	-0.262
M9-131	-1.314
M9-132	-1.112
M9-134	0.038
M9-135	-0.066
M9-136	0.178
M9-137	0.120
M9-138	-0.050
M9-139	-0.503
M9-140	0.230
M9-141	-0.818
M9-143	0.036
M9-144	0.507
M9-145	0.390
M9-201	-0.542
M9-202	0.071
M9-203	-0.523
M9-204	0.788
M9-205	-0.948
M9-206	0.741
M9-207	0.375
M9-208	-0.495
M9-209	1.028
M9-213	-0.533
M9-217	-0.662
M9-218	0.180
M9-219	-0.019
M9-220	0.381
M9-221	0.068
M9-223	-1.421
M9-224	0.056
M9-225	-0.170
M9-226	0.475
M9-227	1.133
M9-228	-0.824
M9-229	0.231
M9-231	-1.612
M9-232	0.688
M9-235	-0.137
M9-236	0.246
M9-238	-0.547
M9-240	0.370
M9-241	0.090
M9-243	-0.061
M9-244	0.427
M9-245	0.398
M9-301	-1.026
M9-302	-0.838
M9-303	0.688
M9-304	-0.121
M9-305	-0.054
M9-306	0.264
M9-307	0.045
M9-308	0.028
M9-309	-0.512
M9-315	0.143
M9-316	-0.603
M9-317	0.272
M9-318	-0.410
M9-320	0.312
M9-321	-0.862
M9-322	-1.375
M9-323	0.261
M9-325	0.779
M9-326	0.016
M9-327	-1.171
M9-329	-1.418
M9-330	0.126
M9-334	0.127
M9-335	-0.080
M9-337	-1.070
M9-338	-0.277
M9-339	0.175
M9-340	-1.472
M9-401	-0.186
M9-402	-0.275
M9-403	-0.818
M9-404	0.248
M9-405	-1.012
M9-406	-0.883
M9-407	0.414
M9-408	0.331
M9-409	-0.233
M9-410	0.371
M9-416	-0.430
M9-417	-1.316
M9-418	-1.498
M9-419	0.692
M9-420	0.166
M9-422	-0.997
M9-423	0.638
M9-424	-0.874
M9-425	0.035
M9-427	0.719
M9-428	-0.924
M9-429	-0.164
M9-430	0.189
M9-433	-0.581
M9-436	0.355
M9-437	-0.498
M9-438	-0.789