

# IEA's Rosetta Stone

## Establishing a Concordance between Regional Assessments and TIMSS/PIRLS

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June 27, 2022



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# Objectives

- TIMSS and PIRLS provide international benchmarks since 1995
- The Rosetta Stone study established a concordance between
  - TIMSS/PIRLS and ERCE
  - TIMSS/PIRLS and PASEC
- This concordance provides confidence regions for ERCE or PASEC results projected onto TIMSS and PIRLS
- ... and can be used to estimate proportions of primary school students achieving international TIMSS and PIRLS proficiency levels

# Implementation

- Successful administration in
  - Colombia and Guatemala (ERCE)
  - Senegal, Guinea, and Burundi (PASEC)
- The same students took their regional assessment (ERCE or PASEC) followed by TIMSS and PIRLS linking booklets in a separate session
- The linking booklets contained TIMSS and PIRLS item blocks from Grade 4
- The assessment was administered to ERCE and PASEC students at Grade 6
- The combined data was used to construct “Rosetta Stone” concordance tables

## Sample – ERCE

- Reduced sample size in Colombia: 1,357 students did not receive TIMSS and PIRLS linking booklets
- No impact of the reduced sample size on results from the population model for Colombia was found

| Country      | Total Number of Students | Number of Students in |                    |                      |                                   |
|--------------|--------------------------|-----------------------|--------------------|----------------------|-----------------------------------|
|              |                          | ERCE only             | Rosetta Stone only | ERCE & Rosetta Stone | ALL ERCE and Rosetta Stone Scales |
| Colombia     | 4,467                    | 1,357                 | 2                  | 3,108                | 2,619                             |
| Guatemala    | 4,894                    | 176                   | 2                  | 4,716                | 3,902                             |
| <b>Total</b> | <b>9,361</b>             | <b>1,533</b>          | <b>4</b>           | <b>7,824</b>         | <b>6,521</b>                      |

Population Modeling

Concordance Donor Selection

# Sample – PASEC

- Rosetta Stone Study took place one year after the PASEC 2019 administration
- Hence, the sample used in the Rosetta Stone study is different from the PASEC 2019 sample
- But both samples are comparable (very similar distribution of plausible values)

| Countries | Number of Students used for the analysis |
|-----------|--|
| Burundi   | 2,271                                    |
| Guinea    | 2,207                                    |
| Senegal   | 2,059                                    |

# Psychometric Analysis

Establishing a concordance was realized with the following analysis steps (separately for ERCE and PASEC)

- 1) The psychometric quality of items was evaluated and confirmed using classical item statistics
- 2) Comparable scales across countries and assessments were established through IRT scaling (evaluation of item-by-country/assessment interactions)
- 3) Latent correlations suggest that constructs from regional assessments (ERCE, PASEC) and constructs from TIMSS/PIRLS are not identical, but similar enough to enable a concordance
  - PASEC:  $r = .78 - .86$
  - ERCE:  $r = .82 - .90$

# Psychometric Analysis

- 4) Posterior means and plausible values were estimated through population modeling
- 5) The plausible values received for PASEC and for ERCE scales were both replicated and could be validated (almost perfect agreement)
- 6) Concordance tables for mathematics and reading, separately for ERCE and PASEC, were constructed based on posterior means and plausible values

For more information see the Rosetta Stone Analysis reports:

<https://timssandpirls.bc.edu/Rosetta-Stone-Reports/>





# Scale Concordance

- Scale concordance establishes a relationship between scores on different assessments or tests that measure similar (but not identical) constructs
- In Rosetta Stone, a range of plausible TIMSS and PIRLS scores is projected from ERCE or PASEC scores
- This prediction can be displayed as a concordance table

# Scale Concordance

- Note, concordance scores are not perfectly equivalent as they do not provide a direct link between assessments
- Moreover, concordance tables vary by different samples as they are dependent on sample characteristics such as
  - Differences in school curricula
  - Test language vs language spoken at home
  - Cultural differences
  - Socioeconomic or sociodemographic differences
  - .....
- Therefore, the uncertainty of the concordance has to be taken into consideration when interpreting results

# Concordance Table for ERCE MATHEMATICS

The concordance table provides a **RANGE** of predicted TIMSS scores for each ERCE score level to account for uncertainty (measurement error)

| ERCE Mathematics Score | Projected Score on TIMSS Scale |    | Lower Bound |     | Upper Bound |     |
|------------------------|--------------------------------|----|-------------|-----|-------------|-----|
|                        | Mean                           | SD | 95%         | 68% | 68%         | 95% |
| 400                    | 290                            | 64 | 162         | 226 | 354         | 417 |
| 420                    | 304                            | 63 | 178         | 241 | 367         | 430 |
| 440                    | 319                            | 62 | 194         | 256 | 381         | 443 |
| 460                    | 318                            | 63 | 192         | 255 | 381         | 444 |
| 480                    | 322                            | 62 | 198         | 260 | 384         | 446 |
| 500                    | 326                            | 62 | 201         | 264 | 389         | 451 |
| 520                    | 334                            | 62 | 211         | 273 | 396         | 458 |
| 540                    | 342                            | 64 | 214         | 278 | 406         | 470 |
| 560                    | 357                            | 63 | 231         | 294 | 419         | 482 |
| 580                    | 371                            | 62 | 247         | 309 | 433         | 495 |
| 600                    | 389                            | 61 | 266         | 327 | 450         | 511 |
| 620                    | 403                            | 61 | 282         | 342 | 463         | 524 |
| 640                    | 420                            | 58 | 303         | 361 | 478         | 537 |
| 660                    | 432                            | 57 | 317         | 375 | 489         | 546 |
| 680                    | 449                            | 53 | 344         | 397 | 502         | 555 |
| 700                    | 465                            | 52 | 362         | 414 | 517         | 569 |
| 720                    | 481                            | 51 | 379         | 430 | 532         | 583 |
| 740                    | 497                            | 49 | 399         | 448 | 547         | 596 |
| 760                    | 515                            | 50 | 415         | 465 | 565         | 616 |
| 780                    | 531                            | 50 | 431         | 481 | 581         | 631 |
| 800                    | 548                            | 48 | 453         | 500 | 596         | 643 |
| 820                    | 563                            | 46 | 471         | 517 | 609         | 655 |
| 840                    | 576                            | 46 | 484         | 530 | 622         | 668 |
| 860                    | 590                            | 45 | 500         | 545 | 635         | 680 |
| 880                    | 599                            | 46 | 508         | 554 | 645         | 691 |
| 900                    | 608                            | 46 | 516         | 562 | 654         | 699 |
| 920                    | 617                            | 48 | 520         | 568 | 665         | 713 |
| 940                    | 624                            | 51 | 522         | 573 | 675         | 726 |
| 960                    | 638                            | 50 | 538         | 588 | 688         | 739 |
| 980                    | 653                            | 49 | 554         | 603 | 702         | 751 |

# Concordance Table for ERCE READING

The concordance table provides a **RANGE** of predicted PIRLS scores for each ERCE score level to account for uncertainty (measurement error)

| ERCE Reading Score | Projected Score on PIRLS Scale |    | Lower Bound |     | Upper Bound |     |
|--------------------|--------------------------------|----|-------------|-----|-------------|-----|
|                    | Mean                           | SD | 95%         | 68% | 68%         | 95% |
| 400                | 284                            | 84 | 116         | 200 | 369         | 453 |
| 420                | 296                            | 83 | 130         | 213 | 380         | 463 |
| 440                | 309                            | 82 | 144         | 226 | 391         | 473 |
| 460                | 321                            | 81 | 158         | 240 | 402         | 483 |
| 480                | 329                            | 80 | 169         | 249 | 409         | 489 |
| 500                | 342                            | 77 | 187         | 265 | 419         | 497 |
| 520                | 347                            | 76 | 195         | 271 | 424         | 500 |
| 540                | 373                            | 74 | 224         | 298 | 447         | 521 |
| 560                | 378                            | 74 | 229         | 303 | 452         | 526 |
| 580                | 395                            | 68 | 258         | 326 | 463         | 532 |
| 600                | 410                            | 65 | 279         | 344 | 475         | 540 |
| 620                | 421                            | 62 | 297         | 359 | 483         | 545 |
| 640                | 436                            | 62 | 311         | 373 | 498         | 560 |
| 660                | 455                            | 63 | 328         | 392 | 518         | 581 |
| 680                | 467                            | 64 | 338         | 402 | 531         | 595 |
| 700                | 482                            | 60 | 362         | 422 | 542         | 602 |
| 720                | 488                            | 63 | 361         | 425 | 551         | 615 |
| 740                | 501                            | 65 | 372         | 437 | 566         | 631 |
| 760                | 522                            | 64 | 393         | 457 | 586         | 650 |
| 780                | 526                            | 63 | 399         | 463 | 590         | 653 |
| 800                | 536                            | 61 | 414         | 475 | 597         | 658 |
| 820                | 546                            | 60 | 425         | 486 | 607         | 667 |
| 840                | 555                            | 60 | 436         | 495 | 614         | 674 |
| 860                | 565                            | 59 | 447         | 506 | 623         | 682 |
| 880                | 568                            | 56 | 456         | 512 | 624         | 680 |
| 900                | 576                            | 56 | 463         | 519 | 632         | 688 |
| 920                | 588                            | 58 | 473         | 530 | 646         | 703 |
| 940                | 596                            | 59 | 477         | 537 | 655         | 715 |
| 960                | 608                            | 58 | 492         | 550 | 666         | 725 |
| 980                | 620                            | 57 | 506         | 563 | 678         | 735 |

# Concordance Table for PASEC MATHEMATICS

The concordance table provides a **RANGE** of predicted TIMSS scores for each PASEC score level to account for uncertainty (measurement error)

| PASEC Mathematics Score | Projected Score on TIMSS Scale |    | 95% Lower Bound | 68% Lower Bound | 68% Upper Bound | 95% Upper Bound |
|-------------------------|--------------------------------|----|-----------------|-----------------|-----------------|-----------------|
|                         | Mean                           | SD |                 |                 |                 |                 |
| 220                     | 197                            | 76 | 44              | 121             | 274             | 350             |
| 240                     | 210                            | 76 | 58              | 134             | 286             | 362             |
| 260                     | 223                            | 75 | 72              | 148             | 298             | 374             |
| 280                     | 224                            | 75 | 74              | 149             | 300             | 375             |
| 300                     | 229                            | 77 | 75              | 152             | 306             | 382             |
| 320                     | 231                            | 76 | 78              | 155             | 307             | 383             |
| 340                     | 235                            | 75 | 85              | 160             | 310             | 385             |
| 360                     | 241                            | 71 | 99              | 170             | 312             | 383             |
| 380                     | 254                            | 69 | 115             | 184             | 323             | 392             |
| 400                     | 265                            | 68 | 130             | 197             | 333             | 401             |
| 420                     | 273                            | 68 | 137             | 205             | 341             | 410             |
| 440                     | 284                            | 65 | 154             | 219             | 349             | 414             |
| 460                     | 297                            | 62 | 172             | 234             | 359             | 421             |
| 480                     | 315                            | 61 | 194             | 254             | 376             | 437             |
| 500                     | 336                            | 63 | 209             | 273             | 399             | 462             |
| 520                     | 344                            | 65 | 215             | 280             | 409             | 473             |
| 540                     | 355                            | 64 | 227             | 291             | 419             | 483             |
| 560                     | 371                            | 63 | 245             | 308             | 434             | 497             |
| 580                     | 382                            | 66 | 251             | 317             | 448             | 514             |
| 600                     | 395                            | 70 | 256             | 326             | 465             | 535             |
| 620                     | 403                            | 71 | 260             | 332             | 475             | 546             |
| 640                     | 417                            | 71 | 274             | 345             | 488             | 559             |
| 660                     | 437                            | 69 | 299             | 368             | 506             | 575             |
| 680                     | 453                            | 69 | 316             | 385             | 522             | 591             |
| 700                     | 469                            | 67 | 335             | 402             | 536             | 602             |
| 720                     | 484                            | 64 | 357             | 421             | 548             | 612             |
| 740                     | 500                            | 57 | 386             | 443             | 556             | 613             |
| 760                     | 513                            | 52 | 408             | 461             | 566             | 618             |
| 780                     | 526                            | 52 | 422             | 474             | 578             | 630             |
| 800                     | 539                            | 51 | 436             | 487             | 590             | 641             |

# Concordance Table for PASEC READING

The concordance table provides a **RANGE** of predicted PIRLS scores for each PASEC score level to account for uncertainty (measurement error)

| PASEC Reading Score | Projected Score on PIRLS Scale |    | 95% Lower Bound | 68% Lower Bound | 68% Upper Bound | 95% Upper Bound |
|---------------------|--------------------------------|----|-----------------|-----------------|-----------------|-----------------|
|                     | Mean                           | SD |                 |                 |                 |                 |
| 220                 | 146                            | 72 | 2               | 74              | 218             | 290             |
| 240                 | 161                            | 72 | 17              | 89              | 233             | 304             |
| 260                 | 175                            | 72 | 31              | 103             | 247             | 319             |
| 280                 | 178                            | 72 | 34              | 106             | 249             | 321             |
| 300                 | 181                            | 72 | 38              | 110             | 253             | 325             |
| 320                 | 190                            | 71 | 47              | 118             | 261             | 332             |
| 340                 | 196                            | 72 | 52              | 124             | 267             | 339             |
| 360                 | 205                            | 71 | 63              | 134             | 276             | 347             |
| 380                 | 216                            | 72 | 73              | 145             | 288             | 359             |
| 400                 | 228                            | 72 | 84              | 156             | 300             | 372             |
| 420                 | 238                            | 76 | 87              | 163             | 314             | 390             |
| 440                 | 253                            | 74 | 104             | 179             | 327             | 401             |
| 460                 | 265                            | 73 | 120             | 193             | 338             | 411             |
| 480                 | 280                            | 71 | 139             | 209             | 351             | 422             |
| 500                 | 297                            | 71 | 155             | 226             | 369             | 440             |
| 520                 | 317                            | 73 | 172             | 244             | 390             | 462             |
| 540                 | 330                            | 72 | 186             | 258             | 402             | 474             |
| 560                 | 351                            | 66 | 219             | 285             | 417             | 482             |
| 580                 | 364                            | 66 | 232             | 298             | 430             | 496             |
| 600                 | 377                            | 68 | 241             | 309             | 446             | 514             |
| 620                 | 392                            | 69 | 255             | 323             | 461             | 529             |
| 640                 | 405                            | 67 | 271             | 338             | 471             | 538             |
| 660                 | 420                            | 63 | 295             | 357             | 483             | 545             |
| 680                 | 444                            | 66 | 312             | 378             | 511             | 577             |
| 700                 | 456                            | 69 | 319             | 388             | 525             | 593             |
| 720                 | 473                            | 71 | 332             | 402             | 544             | 615             |
| 740                 | 486                            | 70 | 346             | 416             | 555             | 625             |
| 760                 | 492                            | 72 | 347             | 420             | 565             | 637             |
| 780                 | 507                            | 72 | 362             | 434             | 579             | 651             |
| 800                 | 521                            | 72 | 377             | 449             | 593             | 665             |

# Estimated Percentages of 6<sup>th</sup>-Grade ERCE Students Reaching the 4<sup>th</sup>-Grade TIMSS International Benchmarks

- We can estimate percentages at or above the benchmarks
- There is variability in countries separate estimates *but on average projections match very well*

| Estimated percentages based on Rosetta Stone |                   |                   |                       |                   |
|--|-------------------|-------------------|-----------------------|-------------------|
| Country                                      | Advanced<br>(625) | High<br>(550)     | Intermediate<br>(475) | Low<br>(400)      |
| Colombia                                     | 2.3 (0.5)         | 15.7 (1.4)        | 47.9 (2.4)            | 81.1 (1.7)        |
| Guatemala                                    | 0.9 (0.3)         | 8.4 (0.9)         | 34.2 (1.6)            | 71.6 (1.7)        |
| <b>Average</b>                               | <b>1.6 (0.3)</b>  | <b>12.0 (0.8)</b> | <b>41.0 (1.4)</b>     | <b>76.3 (1.2)</b> |
| Estimated percentages based on Concordance   |                   |                   |                       |                   |
| Country                                      | Advanced<br>(625) | High<br>(550)     | Intermediate<br>(475) | Low<br>(400)      |
| Colombia                                     | 2.7 (0.5)         | 16.4 (1.3)        | 48.2 (2.2)            | 81.3 (1.5)        |
| Guatemala                                    | 1.1 (0.3)         | 8.1 (1.0)         | 30.4 (1.3)            | 66.6 (1.5)        |
| <b>Average</b>                               | <b>1.9 (0.3)</b>  | <b>12.3 (0.8)</b> | <b>39.3 (1.3)</b>     | <b>73.9 (1.0)</b> |

Note: Standard errors appear in parentheses

# Estimated Percentages of 6<sup>th</sup>-Grade ERCE Students Reaching the 4<sup>th</sup>-Grade PIRLS International Benchmarks

- We can estimate percentages at or above the benchmarks
- There is variability in countries separate estimates *but on average projections match very well*

| Estimated percentages based on Rosetta Stone |                   |                   |                       |                   |
|--|-------------------|-------------------|-----------------------|-------------------|
| Country                                      | Advanced<br>(625) | High<br>(550)     | Intermediate<br>(475) | Low<br>(400)      |
| Colombia                                     | 4.9 (0.7)         | 26.1 (1.9)        | 61.2 (1.9)            | 85.9 (1.2)        |
| Guatemala                                    | 1.0 (0.2)         | 9.1 (0.7)         | 32.7 (1.4)            | 63.2 (1.9)        |
| <b>Average</b>                               | <b>3.0 (0.4)</b>  | <b>17.6 (1.0)</b> | <b>46.9 (1.2)</b>     | <b>74.5 (1.1)</b> |
| Estimated percentages based on Concordance   |                   |                   |                       |                   |
| Country                                      | Advanced<br>(625) | High<br>(550)     | Intermediate<br>(475) | Low<br>(400)      |
| Colombia                                     | 4.3 (0.6)         | 23.2 (1.5)        | 55.7 (1.7)            | 83.6 (1.3)        |
| Guatemala                                    | 1.9 (0.3)         | 11.6 (0.8)        | 36.5 (1.4)            | 67.3 (1.4)        |
| <b>Average</b>                               | <b>3.1 (0.3)</b>  | <b>17.4 (0.8)</b> | <b>46.1 (1.1)</b>     | <b>75.5 (1.0)</b> |

Note: Standard errors appear in parentheses



# Estimated Percentages of PASEC Students Reaching the TIMSS and PIRLS Low (400) International Benchmarks

- We can estimate percentages at or above the benchmarks
- There is variability in countries separate estimates *but on average projections match very well*

| Estimated Percentages based on Rosetta Stone |                   |                   |
|--|-------------------|-------------------|
| Country                                      | TIMSS (400)       | PIRLS (400)       |
| Burundi                                      | 8.9 (1.1)         | 4.1 (0.7)         |
| Guinea                                       | 16.6 (2.0)        | 19.7 (2.1)        |
| Senegal                                      | 47.5 (3.7)        | 41.0 (3.9)        |
| <b>Average</b>                               | <b>24.3 (1.5)</b> | <b>21.6 (1.5)</b> |
| Estimated Percentages based on Concordance   |                   |                   |
| Country                                      | TIMSS (400)       | PIRLS (400)       |
| Burundi                                      | 29.3 (1.8)        | 10.5 (1.0)        |
| Guinea                                       | 10.1 (1.7)        | 15.6 (2.2)        |
| Senegal                                      | 34.6 (3.1)        | 36.3 (3.4)        |
| <b>Average</b>                               | <b>24.7 (1.3)</b> | <b>20.8 (1.4)</b> |

Note: Standard errors appear in parentheses

# Limitations of the Concordance Tables

The concordance tables are based on the analysis of samples from 2 (out of 18) ERCE countries and 3 (out of 14) PASEC countries and the results need to be accompanied by some cautionary notes:

- The differences in the measured constructs make the concordance projections vary more than direct TIMSS and PIRLS measures
- The study used somewhat smaller sample sizes compared to typical sizes of national samples in PASEC and a reduced sample size in ERCE
- Potential curricular differences and differences between test language and language spoken at home may contribute to larger conditional variance in the projections

# Summary

- While the concordance has its limitations, it is the best tool at the moment to allow comparisons between regional assessments and international benchmarks
- It helps comparing difficulty levels between regional assessments (ERCE, PASEC) and TIMSS/PIRLS
- Results based on concordance and benchmark percentages allow studying the achievement distributions of regional assessments and TIMSS/PIRLS
- Larger national sample sizes and adding more countries in the Rosetta Stone project would further stabilize this estimated concordances for both ERCE and PASEC

# Thank you!

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