IEA’s LaNA and Rosetta Stone: Extending the Reach of TIMSS and PIRLS

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Extending TIMSS and PIRLS

TIMSS and PIRLS achievement scales and benchmarks long established global indicators of student achievement

Two distinct efforts to build on TIMSS and PIRLS:

- LaNA: a new, less difficult Literacy and Numeracy assessment for countries where TIMSS and PIRLS are too difficult
- Rosetta Stone: linking TIMSS and PIRLS to regional assessments – ERCE, PASEC, SACMEQ, SEA-PLM, PILNA
- Address progress toward UN Sustainable Development Goal 4.6
  - Ensure inclusive and quality education for all and promote lifelong learning.
- Linking through concordance tables – projecting TIMSS and PIRLS scores from scores on other assessments
Example Concordance: ACT and SAT

- LaNA and Rosetta Stone concordance tables will be similar to the ACT – SAT example
- Will provide a range of likely TIMSS/PIRLS scores for each LaNA or regional assessment score
  - Account for measurement error
## ACT Composite to SAT Total

This table shows a range of SAT scores for each ACT score.

<table>
<thead>
<tr>
<th>ACT</th>
<th>SAT</th>
<th>SAT Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>1590</td>
<td>1570-1600</td>
</tr>
<tr>
<td>35</td>
<td>1540</td>
<td>1530-1560</td>
</tr>
<tr>
<td>34</td>
<td>1500</td>
<td>1490-1520</td>
</tr>
<tr>
<td>33</td>
<td>1460</td>
<td>1450-1480</td>
</tr>
<tr>
<td>32</td>
<td>1430</td>
<td>1420-1440</td>
</tr>
<tr>
<td>31</td>
<td>1400</td>
<td>1390-1410</td>
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<td>30</td>
<td>1370</td>
<td>1360-1380</td>
</tr>
<tr>
<td>29</td>
<td>1340</td>
<td>1330-1350</td>
</tr>
<tr>
<td>28</td>
<td>1310</td>
<td>1300-1320</td>
</tr>
<tr>
<td>27</td>
<td>1280</td>
<td>1260-1290</td>
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<td>1200-1220</td>
</tr>
<tr>
<td>24</td>
<td>1180</td>
<td>1160-1190</td>
</tr>
<tr>
<td>23</td>
<td>1140</td>
<td>1130-1150</td>
</tr>
<tr>
<td>22</td>
<td>1110</td>
<td>1100-1120</td>
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<td>21</td>
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<td>20</td>
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<td>1030-1050</td>
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<tr>
<td>19</td>
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<td>18</td>
<td>970</td>
<td>960-980</td>
</tr>
<tr>
<td>17</td>
<td>930</td>
<td>920-950</td>
</tr>
<tr>
<td>16</td>
<td>890</td>
<td>880-910</td>
</tr>
<tr>
<td>15</td>
<td>850</td>
<td>830-870</td>
</tr>
<tr>
<td>14</td>
<td>800</td>
<td>780-820</td>
</tr>
<tr>
<td>13</td>
<td>760</td>
<td>730-770</td>
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<td>12</td>
<td>710</td>
<td>690-720</td>
</tr>
<tr>
<td>11</td>
<td>670</td>
<td>650-680</td>
</tr>
<tr>
<td>10</td>
<td>630</td>
<td>620-640</td>
</tr>
<tr>
<td>9</td>
<td>590</td>
<td>590-610</td>
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</tbody>
</table>
Overview of LaNA

- IEA’s new less difficult Literacy and Numeracy assessment, with links to TIMSS and PIRLS
  - *Addresses the same constructs, with shorter, easier items*
- Current LaNA instrument the result of several waves of piloting – now ready for full scale implementation
- IEA seeking 5-10 countries to participate in launch of LaNA
  - Establish the LaNA scale metric
    - Construct concordance tables for LaNA vs TIMSS and PIRLS
    - Establish new “Basic” benchmark, below TIMSS/PIRLS Low International benchmark
LaNA Assessment Framework and Items

**Numeracy** – based on TIMSS mathematics 4\(^{th}\) grade
- Number, Measurement & Geometry, Data
- Mostly Knowing, Applying, some reasoning
- TIMSS items too difficult, so all LaNA items newly developed

**Literacy** – based on PIRLS reading 4\(^{th}\) grade
- Literary and Informational purposes for reading
- Mostly retrieval and straightforward inferencing, some integrating
- All passages and items adapted from PIRLS Literacy – shorter and easier
Extensive Piloting of LaNA Prototypes

- Early versions (LaNA 1.0 and 2.0) piloted in Haiti and Pakistan (2016, 2017)

- Large scale pilots (LaNA 3.0) in Serbia, North Macedonia, Nigeria, and Haiti (2019, 2020)

<table>
<thead>
<tr>
<th>Countries</th>
<th>N (used for analysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LaNA Pilot</td>
<td></td>
</tr>
<tr>
<td>Serbia (Grade 3)</td>
<td>1,295</td>
</tr>
<tr>
<td>North Macedonia (Grade 3)</td>
<td>1,196</td>
</tr>
<tr>
<td>Nigeria (Grade 4)</td>
<td>884</td>
</tr>
<tr>
<td>Haiti (Grade 4)</td>
<td>952</td>
</tr>
<tr>
<td>Haiti (Grade 6)</td>
<td>706</td>
</tr>
</tbody>
</table>
LaNA Pilot Data Collection

• Four LaNA booklets
  – Five blocks of Numeracy items (one common)
  – Five literacy passages and items (one common)

• One linking booklet
  – Easy items from TIMSS 2015/2019 and PIRLS 2016

• Data collection design in pilot
  – Two-day model: LaNA and linking booklets on successive days, each student completes one of each
LaNA Pilot Data Analyses and Design

• Extensive analyses of pilot data using classical item analyses and IRT scaling
  • Comparability of the measured constructs across instruments
  • Comparability of the difficulty targets of LaNA and TIMSS/PIRLS
  • Reliability and construct coverage of the constructed scales
  • Fit of TIMSS and PIRLS item parameters for LaNA participants

• LaNA 4.0 assessment instrument finalized based on pilot results
  – Item selection and test design

• LaNA linking design strengthened and finalized
LaNA Booklet Design

- Four blocks Numeracy Items (N1-N4), chained across booklets
- Five Literacy passages (L0, L1-L4), common + unique

<table>
<thead>
<tr>
<th>LaNA Booklets</th>
<th>Part 1 (40 min)</th>
<th>Part 2 (40 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N1</td>
<td>N2</td>
</tr>
<tr>
<td>2</td>
<td>L0_Common</td>
<td>L2</td>
</tr>
<tr>
<td>3</td>
<td>N3</td>
<td>N4</td>
</tr>
<tr>
<td>4</td>
<td>L0_Common</td>
<td>L4</td>
</tr>
</tbody>
</table>

L0_Common, L1, L2, L3, L4, N1, N2, N3, N4
LaNA Linking Booklet Design

- Four blocks less difficult TIMSS Items (NL1-NL4), chained across booklets
- Four PIRLS Literacy passages (LL1-LL4), also chained across booklets

<table>
<thead>
<tr>
<th>Linking Booklets</th>
<th>Part 1 (40 min)</th>
<th>Part 2 (40 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NL1</td>
<td>NL2</td>
</tr>
<tr>
<td>2</td>
<td>LL2</td>
<td>NL2</td>
</tr>
<tr>
<td>3</td>
<td>NL3</td>
<td>LL3</td>
</tr>
<tr>
<td>4</td>
<td>LL4</td>
<td>NL4</td>
</tr>
</tbody>
</table>

Note: LL1 is chained with NL2 in Part 1 and LL1 is also linked in Part 2; similarly for NL1-NL4 and LL1-LL4.
LaNA Implementation

- The final LaNA instrument together with the linking booklets will be administered to 5-10 seed countries
- Instruments, administration manuals and scoring guides have been shared with IEA
  - French translations underway
- Senegal the first participating country
  - November 2021
LaNA Implementation (cont.)

• Data collection design
  – One-day model: all 8 (LaNA and linking) booklets distributed in each class

• Data from the seed countries will be used to
  – Establish LaNA scale and scale metric
  – Create LaNA-TIMSS/PIRLS concordance tables
  – Create new “Basic” International Benchmark
Benefits for LaNA Countries

• Reliable, valid, and internationally comparable indicators of student literacy and numeracy
  – Ideal for measuring progress toward SDG 4

• Concordance tables provide LaNA countries’ projected scores on TIMSS and PIRLS
  – Also estimates of percentages of students reaching TIMSS and PIRLS International Benchmarks

• Progress toward suitability for participation in TIMSS and PIRLS
Overview of Rosetta Stone

- Objective: “Translate” or link to TIMSS/PIRLS from regional assessments – ERCE, PASEC, SACMEQ, SEA-PLM, PILNA
- Funded by UNESCO, representative countries from two assessments
  - ERCE: Guatemala, Colombia (Chile out due to COVID-19)
  - PASEC: Burundi, Guinea, Senegal
- TIMSS/PIRLS items administered to students participating in ERCE or PASEC
  - Provides psychometric link to establish concordance
- Can report “likely” performance on TIMSS/PIRLS based on ERCE or PASEC results
Students participating in the ERCE or PASEC assessments at sixth grade also were administered TIMSS and PIRLS booklets in a separate session

- Equivalent sample design

Eight linking booklets

- For ERCE, medium and easy items from TIMSS 2015/2019 and PIRLS 2016

- For PASEC, all easy items from TIMSS 2015/2019 and PIRLS 2016
Rosetta Stone Project Status

- Successful administration of Rosetta Stone in 2020 (in spite of delays due to Covid-19)
- Data received from five countries and processed for analysis

<table>
<thead>
<tr>
<th>Countries</th>
<th>N (used for analysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERCE</td>
<td></td>
</tr>
<tr>
<td>Guatemala (Grade 6)</td>
<td>3,144</td>
</tr>
<tr>
<td>Colombia (Grade 6)</td>
<td>5,340</td>
</tr>
<tr>
<td>PASEC</td>
<td></td>
</tr>
<tr>
<td>Burundi (Grade 6)</td>
<td>2,271</td>
</tr>
<tr>
<td>Guinea (Grade 6)</td>
<td>2,207</td>
</tr>
<tr>
<td>Senegal (Grade 6)</td>
<td>2,059</td>
</tr>
</tbody>
</table>
Data Quality and Analysis

• Rosetta Stone requires careful analysis and review of the data in order to determine:
  o The quality of the data base for comparison between national and international assessments
  o The psychometric quality of the items
  o The measurement accuracy (measurement error)

• This is done by applying standard TIMSS/PIRLS data quality control procedures, statistical analysis and psychometric models
Psychometric Analyses

• Establishing a concordance between the ERCE/PASEC data and the TIMSS/PIRLS international scales/benchmarks requires the following Psychometric analysis step:
  - Establishing comparability through IRT scaling
  - Applying TIMSS/PIRLS item parameters to ERCE/PASEC data
  - Producing plausible values through population modeling
  - Validating and replicating the plausible values received in the ERCE/PASEC data sets
  - Building a concordance table based on derived plausible values
Rosetta Stone Project Status - PASEC

• Final data from Burundi, Guinea, and Senegal at TIMSS & PIRLS ISC, May 2021
  – Quality checks completed and almanacs produced, June 2021

• As expected, TIMSS and PIRLS item blocks are more difficult than PASEC Mathematics and Reading blocks
  – However, the difficulty level of the TIMSS and PIRLS items seems appropriate for Rosetta Stone analyses

• TIMSS and PIRLS item parameters show a good fit for the majority of link items

• Draft results of psychometric analyses presented to PASEC countries, September 23, 2021
Average P+ by Item Block
TIMSS vs. PASEC Mathematics

Average P+ by TIMSS 2015/2019 Block

Average P+ by PASEC Mathematics Block
Average P+ by Item Block
PIRLS vs. PASEC Reading

Average P+ by PIRLS 2016 Block

Average P+ by PASEC Reading Block
Rosetta Stone Status - ERCE

• Some delays due to COVID-19

• Classical item statistics and IRT scaling conducted on preliminary data

• Similar to PASEC, TIMSS and PIRLS items appear to be more difficult than ERCE Mathematics and Reading blocks

• Again, however, the difficulty level of the TIMSS and PIRLS blocks seems appropriate for the Rosetta Stone analyses

• Analysis will be finalized once the updated/final data files have been received
Reporting

- Concordance tables will be provided to translate between ERCE/PASEC and TIMSS/PIRLS achievement scales
  - Confidence intervals will be reported to account for measurement and linking error

- Using the concordance tables, it will be possible to
  - Estimate the expected TIMSS or PIRLS score corresponding to each ERCE/PASEC score
  - Determine the ERCE/PASEC scores corresponding to TIMSS/PIRLS International Benchmarks
  - Estimate the percent of students in each country that would have reached the TIMSS and PIRLS benchmarks

- Technical documentation of all results will be provided
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