early learning measurement tools

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SYNOPSIS OF THE STANDARDISATION AND NORMS FOR THE ELOM-R (V1)

Language and Mathematics Assessments

1ST EDITION 2025

This document draws on the ELOM-R (v1) Language and Mathematics Assessment Technical Manuals developed on behalf of DataDrive2030 by Matthew Kleineibst (Psychology Department, University of Cape Town and Ax Consult), Jürgen Becker (Industrial Psychology Department, University of the Western Cape and Ax Consult) and Andrew Dawes (Psychology Department, University of Cape Town and DataDrive2030).

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INTRODUCTION

This document provides a synopsis of the Standardisation and Norms for the ELOM-R Language and Mathematics (v1) Assessments. By using the suffix (v1), we follow the test development convention to indicate that this is the first version of the ELOM-R. All tests develop over time, and it is always important to distinguish which version is used for an analysis.

Both tests have been set with standards for expected performance on the ELOM-R (v1), and the process used to derive them is outlined below. Standards cut-scores are included in the norms for both tests.

ELOM-R (V1) STANDARDS

PROCESS

Performance standards describe what children should know and be able to do at particular levels – in this case, at the end of the Grade R year. As described in ELOM-R (v1) Technical Manual 1 (Dawes & Biersteker, 2025), items in both the ELOM-R (v1) Mathematics and Language tests are closely aligned with the Grade R Curriculum Assessment Policy Statements (CAPS) specified by the National Department of Basic Education. Their development was also informed by research on predictors of Foundation Phase learning outcomes, consultations with experts in the field of early education, Foundation Phase educators, and a review of other available measures.

The process for setting ELOM-R (v1) standards followed the same process as for the ELOM 4&5 Years Assessment Tool. As noted in the ELOM 4&5 Technical Manual, it is international practice to set early learning standards between the 50th and 60th percentile of the norm sample standardised score distribution.

- A provisional benchmark for a child or a group being *"On Track"* was set at the 60th percentile of the standardised score distribution (equivalent to the percent correct score achieved by the top 40% of children in the standardisation sample).
- That proposal was discussed at a standards setting consultation in December 2024 with external experts in the field and the DataDrive2030 psychometrics team.
- The 60th percentile was confirmed for both the ELOM-R (v1) Mathematics and Language Assessments, and following the practice used in the development of the ELOM 4&5, scores between the 32nd and 59th percentiles were classified as *"Falling Behind"*. In contrast, those below the 32nd percentile were classified as *"Falling Far Behind"*.
- These bands are used for interpretive purposes in the norms that follow.

Table 1. ELOM-R Language (v1) Items

GRADE R CAPS AREA	ITEM	NUMBER OF TRAILS
LISTENING & SPEAKING Vocabulary and oral language	1. Productive Vocabulary (3)	36
	7. Listening Comprehension (9)	10
READING & PHONICS Phonemic awareness and the underpinning auditory, visual and spatial perception required for reading. Letter, word and initial consonant recognition.	2. Beginning Sounds (4)	8
	3. Letter Sounds (5)	8
WRITING & HANDWRITING Drawing and emergent writing skills; underpinning perceptual & motor skills; spatial and visual awareness	4. Copy Shapes (6)	4
	5. Write name (7)	1
	6. Writing with encouragement (8)	1
UNDERSTANDING OF PRINT Understanding the orthographic system and written language	8. Book concept, orientation, and word concept (10)	9

ELOM-R (V1) LANGUAGE STANDARDISATION SAMPLE

Psychometric analyses were undertaken on a combined sample of eight languages to standardise the ELOM-R Language (v1) and derive norms that can be used to compare the performances of groups of children regardless of language. The sample is provided in Table 2.

Table 2. ELOM-R Language (v1) Standardisation Sample

Home Language	Total	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1. English	281	13	34	118	47	69
2. Afrikaans	447	86	82	37	141	101
3. isiZulu	280	43	55	62	81	39
4. isiXhosa	291	23	74	102	57	35
5. Sesotho	289	68	64	76	46	35
6. Setswana	277	241	0	21	8	7
7. Sepedi	282	214	13	23	16	16
8. Tshivenda	292	100	63	109	20	0
TOTAL	**2439**	**788**	**385**	**548**	**416**	**302**
Final Total after exclusion of outliers	**2431**					

The poor representation of quintile 4 and 5 children in some languages will affect findings. Language and quintile are confounded.

First, the distribution of total scores on the Language assessment is reported. Item-level scores are the percentage of correct responses to trials comprising test items (PC scores). Test scores are calculated based on these percentage scores, yielding a decimal scale ranging from 0 to 1. The histogram of total PC scores across the sample is presented in Figure 1, and descriptive statistics describing the distribution's range, central tendency, and shape are presented in Table 3.

The standardisation ELOM-R Language (v1) sample histogram in Figure 1 reveals a reasonably symmetrical distribution.

Figure 1. ELOM-R Language (v1) Standardisation Sample Mean Percent Correct Score Distribution

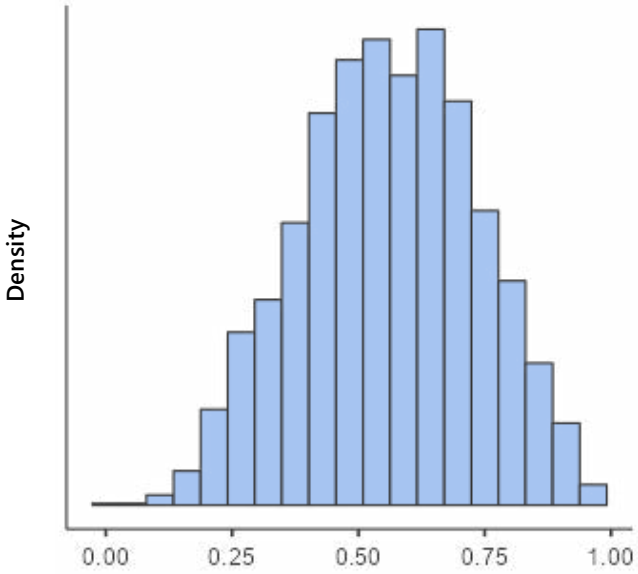


Table 3. ELOM-R Language (v1) Total Percent Correct Score Descriptive Statistics

N	MEAN	MEDIAN	SD	MINIMUM	MAXIMUM
2431	0.656	0.665	0.173	0.026	0.991

SKEWNESS		KURTOSIS	
SKEWNESS	SE	KURTOSIS	SE
0.271	0.050	-0.582	0.099

Skewness is statistically significant. However, the value is below the threshold for meaningful distortion distribution, and it is reasonable to proceed with standardisations.

The final standardisation group comprises 2431 cases.

ELOM-R LANGUAGE (V1) STANDARDISATION SAMPLE SCHOOL QUINTILE DISTRIBUTIONS

As scores are normalised across South Africa's diverse population, language groups and socioeconomic status (SES) are reported. While both group designations are important to consider in their own right, as previously noted, they are heavily confounded in South Africa (Laher et al., 2019).

Figure 2 presents the school quintile composition of each language group, providing context for considering potential confounding effects. SES is operationalised in terms of the quintiles assigned to the schools from which children were sourced. These are further collapsed into schools that do not require fee payment (quintiles 1, 2, and 3), and those that do (quintiles 4 and 5).

Figure 2. ELOM-R Language (V1) Standardisation Sample School Quintile Distribution

Fee-paying schools predominated for the Afrikaans cohort alone, with comparable proportions of paying and non-paying schools in the English and isiZulu samples. Fee-paying isiXhosa and Sesotho schools are well outnumbered by non-paying schools, while very low to negligible proportions of Sepedi, Setswana, and Tshivenda schools pay fees. Table 4 displays school quintile frequencies for each language in the sample.

Table 4. ELOM-R Language (v1): Quintile Frequencies by Language

SCHOOL QUINTILE	AFRIKAANS	ENGLISH	SESOTHO	SEPEDI	SETSWANA	TSHIVENDA	ISIXHOSA	ISIZULU
1	83	13	68	214	241	100	23	43
2	82	34	63	13	0	62	74	55
3	37	118	75	23	21	109	102	62
4	139	47	46	16	8	20	57	81
5	101	69	35	16	7	0	35	39
Not Paying Fees (Q 1 – 3)	202	165	206	250	262	271	199	160
Paying Fees (Q 4 & 5)	240	116	81	32	15	20	92	120

**Modal values indicated in red text*

Table 4 reveals very different school quintile distributions across the language groups. Sepedi, Setswana, and Tshivenda fee-paying schools are underrepresented, and SES effects are likely to influence these cohorts heavily. The quintile frequencies suggest that the Sesotho cohort may be less affected than Sepedi or Setswana, as they possess far greater numbers of quintile 2 and 3 schools. Subsamples for paying and non-paying schools for all other language groups appear reasonably well populated.

PSYCHOMETRIC PROPERTIES OF THE ELOM-R LANGUAGE (V1) STANDARDISATION SAMPLE

RELIABILITY

Reliability testing procedures were taken to assess whether the ELOM-R (v1) Language items consistently measure language abilities defined in the DBE CAPS for Grade R across all the subsamples included in the overall norm. The reliability of the assessment was tested using McDonald's omega (ω), which assesses the internal consistency of assessment scores. Results are presented in Table 5.

Table 5 ELOM-R Language (v1) Reliability Statistics

	Item-rest correlation	ω
ELOM-R Language (V1) Scale		**0.763**
When the item is excluded...		
1. Productive vocabulary	0.315	0.761
2. Beginning sounds	0.615	0.708
3. Letter sounds	0.641	0.706
4. Copying shapes	0.352	0.756
5. Write name	0.326	0.760
6. Writing with encouragement	0.541	0.725
7. Listening comprehension	0.363	0.754
8. Book concept, orientation, and word concept	0.529	0.726

All values exceed the acceptable threshold (0.70), but items 2 and 3 are marginal. These are phoneme awareness items, and their reliability may be affected by the different phonetic structures of the African and Germanic languages (English and Afrikaans). No items produce sub-threshold item-rest correlations ($r > 0.3$) or detract from scale reliability (ω when item removed < 0.763). The ELOM-R Language (v1) Assessment can be considered a reliable measure.

A confirmatory factor model (CFA) was fitted to the norm sample to assess construct validity.

CONFIRMATORY FACTOR ANALYSIS (CFA)

A unidimensional factor model was specified, and fit statistics in Table 6 describe the fit of this model to the observed data. Factor loadings of individual items to the single factor are evaluated to assess potential misfit at the item level. CFA loadings are presented in Table 7.

Table 6 ELOM-R Language (v1) Assessment CFA Model Fit

χ^2	df	P	CFI	TLI	RMSEA	Lower CI	Upper CI
468.06	20	< .001	0.889	0.845	0.096	0.089	0.104

Table 7 ELOM-R Language (v1) Reliability Statistics

Item	Estimate	SE	Z	P	λ
1. Productive vocabulary	0.050	0.003	16.072	< .001	0.351
2. Beginning sounds	0.264	0.007	36.875	< .001	0.719
3. Letter sounds	0.248	0.006	39.68	< .001	0.767
4. Copying shapes	0.095	0.006	17.164	< .001	0.374
5. Write name	0.089	0.005	16.828	< .001	0.365
6. Writing with encouragement	0.240	0.007	33.301	< .001	0.665
7. Listening comprehension	0.088	0.005	17.923	< .001	0.393
8. Book concept, orientation, and word concept	0.151	0.006	26.835	< .001	0.562

Model misfit is evident for the ELOM-R Language (v1) assessment single factor model (RMSEA = 0.096, CFI = 0.889, TLI = 0.845). While all items load saliently ($\lambda > 0.3$, $p < .001$), the construct validity of the Language assessment is not clearly established.

If more items were added to the assessment that tap the CAPS Drawing, Emergent Writing, and Understanding of Print in particular, additional underlying factors could be evident. Subsequent versions of this instrument will investigate this further. The current version of the instrument must be regarded as provisional.

Despite these limitations, the ELOM-R Language (v1) assessment can be considered a reliable scale suitable for norming.

Standardisation

As the ELOM-R Language (v1) assessment was designed to test the achievement of children exiting Grade R / entering Grade 1 across a highly diverse population, it is essential to establish precise, meaningful score distributions. This was achieved through normalisation and standardisation techniques (Cohen et al., 1996; Kline, 2000).

Normalisation **involves transforming raw scores into standard (Z-scores) such that they are:**
a) centred on zero according to the population mean, and
b) scaled according to the data's spread (standard deviation) around the mean.

This allows scores across assessments and groups to be compared according to their distribution-relative distance from the mean.

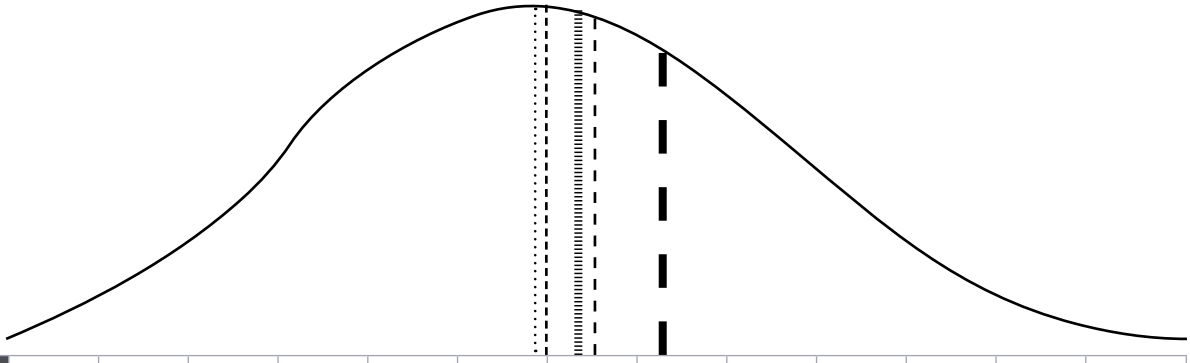
Percentile ranking is another standardisation procedure that involves transforming raw scores to represent individuals' performance relative to typical performance on the assessment. For a given raw score, its percentile-ranked equivalent represents the proportion of the raw score distribution that falls equal to or below it. A standardised score distribution has been derived, allowing for population-referenced, standardised scores to be calculated.

As this assessment aims to evaluate the attainment of educational standards applicable across quintile groups with known ability distribution differences, the observed median score differences are acceptable. The norm tables show that the children's scores are related to the quintile of their school. Figure 3[1] presents the standardised distributions of both raw and normalised Mathematics scores. Raw scores across the entire sample of respondents are transformed into Z-scores, and columns represent increments of Z, starting at -3 and ending in + 3. For each increment of Z (representing half standard deviation units), normed and raw percent correct (PC) scores corresponding to these distribution points are presented. Raw score counterparts to each Z interval are also presented by quintile, representing the scores corresponding to the indicated Z value within each school quintile-specific subsample. Median raw scores per quintile group in relation to the normalised distribution are indicated with dashed lines overlaid on the distribution curve; a key for this is presented under the standardisation table. Median score differences between quintiles across increments of Z are presented in vertical bars.

Table 8 provides standardised (percentile-ranked) raw scores, Raw Percentage Correct scores, and Z-normalised scores for reference purposes. These can be used to compare groups of children on the norms.

[1] For these calculations, each trial in each item is scored correct/incorrect. The proportion of trials correctly answered in each item is the Raw Percent Correct score for that item. The Raw Percent Correct score on the test as a whole is reported in the Figure and the Table and is the average item percent correct score for all items.

Figure 3. ELOM-R Language (v1) Standard Score Distribution



	Z-Score	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3
	Norm Score (Percentile)	**0.0**	**0.5**	**2.6**	**7.6**	**17.6**	**30.0**	**47.9**	**66.1**	**81.5**	**95.1**	**99.9**	**100**	**100**
Raw Percentage Correct Scores	**Norm Sample**	**13.8**	**22.4**	**31.0**	**39.7**	**48.3**	**56.9**	**65.6**	**74.2**	**82.8**	**91.4**	**100**	**100**	**100**
	Quintile 1	11.9	20.5	29.1	37.6	46.2	54.8	63.3	71.9	80.5	89.0	97.6	100	100
	Quintile 2	9.9	18.8	27.7	36.6	45.5	54.4	63.3	72.2	81.1	90.0	98.9	100	100
	Quintile 3	15.3	23.7	32.0	40.3	48.7	57.0	65.4	73.7	82.0	90.4	98.7	100	100
	Quintile 4	16.7	24.9	33.0	41.2	49.4	57.5	65.7	73.9	82.0	90.2	98.4	100	100
	Quintile 5	24.9	33.1	41.4	49.6	57.8	66.0	74.2	82.5	90.7	98.9	100	100	100

Key: Quintile Median scores are indicated in lines on Figure 3.

Quintile median	**1**	**63.3%**
Quintile median	**2**	**63.3%**
Quintile median	**3**	**65.4%**
Quintile median	**4**	**65.67**
Quintile median	**5**	**74.2%**

Table 20. ELOM-R Mathematics (v1) Standardised Score Reference Table

KEY	
RAW SCORE	The Raw (Percentage Correct) score on the test ranging from 0 to 100. Note: Raw scores on each ELOM-R (v1) item have different scales. For example, a child can obtain a score from -1 to 20 on item 1 and a score from -1 to 10 on item 2. It is obvious that these two items have different scales. When a test is standardised, all scores must be converted to the same scale. For this reason, all ELOM-R (v1) item scores are converted to percentage correct total scores on the test, ranging from 0-100.
Z	Z-scores range from -3 to +3 (in a normal distribution). The Z-score indicates the distance of the raw percentage correct score from the mean of the distribution in standard deviation units either above (+) or below (-) the mean (in a normal distribution, such as the mean and the median have the same value). When two tests have Z-scores, these are then on the same scale and can be used in statistical analyses to compare scores on the two tests.
PERCENTILE	This value shows the percentage of the standardisation sample whose scores fall below the corresponding Raw Percentage Correct score. The percentile rank is the band of scores below the percentile.
COLOUR CODING	ELOM-R (v1) standards bands are shown on the table: ***Green: On Track: => 60th percentile*** ***Orange: Falling Behind: 32nd-59th percentile*** ***Red: Falling Far Behind: <32nd percentile***

INTERPRETATION OF ELOM-R LANGUAGE (V1) RAW SCORES

Steps
1: Calculate the mean % correct raw score for your sample.
2: Use the norm table to look up the corresponding percentile and Z-score values for that score. This will tell you how your sample compares with the standardisation sample used to construct the ELOM-R Language (v1) norms.

Example:
*If your sample's mean Raw score = 57.3, it falls at the 32nd percentile of the standardised distribution. This indicates that your group scored in the same range as 32% of the standardisation sample who scored 57,3 or less on this test. The corresponding Z score in the table tells you how many standard deviations above (+) or below (-) your sample's score is from the mean. The corresponding Z-score in the table indicates how many standard deviations above (+) or below (-) your sample percentage correct score is from the **mean** of the standardisation sample, in this case, **0.50** standard deviations below the standardisation sample mean.*

FALLING FAR BEHIND			FALLING BEHIND			ON TRACK		
Raw Score	Z	Percentile	Raw Score	Z	Percentile	Raw Score	Z	Percentile
16.4	-2.85	0	57.5	-0.47	32	71.7	0.35	**60**
25.6	-2.31	1	58.0	-0.44	33	72.2	0.39	61
28.5	-2.15	2	58.5	-0.41	34	72.6	0.41	62
31.9	-1.95	3	59.2	-0.37	35	73.1	0.44	63
34.0	-1.83	4	59.8	-0.34	36	73.6	0.47	64
36.1	-1.71	5	60.2	-0.31	37	74.1	0.50	65
37.7	-1.61	6	60.7	-0.28	38	74.5	0.52	66
38.9	-1.55	7	61.1	-0.26	39	74.8	0.54	67
40.0	-1.48	8	61.5	-0.24	40	75.5	0.57	68
41.0	-1.42	9	62.2	-0.20	41	75.8	0.59	69
41.8	-1.38	10	62.7	-0.17	42	76.3	0.62	70
42.6	-1.33	11	63.1	-0.14	43	76.7	0.65	71
43.4	-1.28	12	63.5	-0.12	44	77.2	0.67	72

FALLING FAR BEHIND			FALLING BEHIND			ON TRACK		
Raw Score	Z	Percentile	Raw Score	Z	Percentile	Raw Score	Z	Percentile
44.6	-1.22	13	64.0	-0.09	45	77.7	0.70	73
45.4	-1.17	14	64.5	-0.06	46	78.1	0.72	74
46.5	-1.10	15	65.1	-0.03	47	78.8	0.77	75
47.0	-1.07	16	65.6	0.00	48	79.2	0.79	76
48.1	-1.01	17	66.0	0.02	49	79.9	0.83	77
48.8	-0.97	18	66.5	0.05	50	80.7	0.88	78
49.5	-0.93	19	67.2	0.09	51	81.1	0.90	79
50.0	-0.90	20	67.5	0.11	52	81.6	0.93	80
50.5	-0.87	21	67.9	0.14	53	82.1	0.96	81
51.2	-0.83	22	68.4	0.16	54	82.7	1.00	82
51.7	-0.80	23	69.1	0.20	55	83.3	1.03	83
52.4	-0.76	24	69.5	0.23	56	84.2	1.08	84
52.9	-0.73	25	70.2	0.27	57	84.8	1.12	85
53.6	-0.69	26	70.7	0.30	58	85.7	1.17	86
54.4	-0.65	27	71.2	0.33	59	86.1	1.19	87
55.0	-0.61	28				86.8	1.23	88
55.8	-0.57	29				87.4	1.27	89
56.4	-0.53	30				88.1	1.30	90
57.0	-0.49	31				88.9	1.35	91
						89.7	1.40	92
						90.3	1.44	93
						90.9	1.47	94
						91.5	1.50	95
						92.5	1.56	96
						93.9	1.64	97
						95.3	1.72	98
						97.2	1.84	99
						100.0	2.00	100

GRADE R CAPS AREA	ITEM	NUMBER OF TRAILS
NUMBER SENSE AND OPERATIONS	1. Count forwards to 20	1
	2. Count backwards from 10	1
	3. Counting from a given number	2
	4. Skip counting in twos to 10	1
	5. Count with 1:1 correspondence	1
	6. Number order	2
	7. Number recognition	6
	8. Subitise to 5	5
	9. Knowledge of ordinal Numbers	6
	10. Compare two collections of objects	4
	11. Show a collection without counting	5
	12. Solving addition and subtraction problems	4
	13. Solving sharing and grouping problems	3
SHAPE AND SPACE	14. Shape and space construction (copy shape from models)	2
MEASUREMENT	15. Sorting & Grouping	4
SHAPE AND SPACE	16. Shape identification and understanding	6
PATTERNS, FUNCTIONS, AND ALGEBRA	17. Pattern extension	7
	18. Pattern completion	1

ELOM-R MATHEMATICS (V1) STANDARDISATION SAMPLE

Psychometric analyses were undertaken on a combined sample of eight languages to standardise the ELOM-R Mathematics (v1) Assessment and derive norms that can be used to compare the performances of groups of children regardless of language. The standardisation sample is provided in Table 2.

Table 2. ELOM-R Mathematics (v1) Sample for Standardisation and Norms

Home Language	Total	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1. English	282	14	33	118	48	49
2. Afrikaans	448	84	84	38	141	101
3. isiZulu	281	43	56	61	82	39
4. isiXhosa	290	23	74	101	57	35
5. Sesotho	287	68	64	76	46	35
6. Setswana	276	240	0	21	8	7
7. Sepedi	286	218	13	23	16	16
8. Tshivenda	290	98	63	109	20	0
TOTAL after exclusion of outliers	**2440**	**788**	**386**	**546**	**418**	**302**

It was established that the isiZulu group had two cases with markedly low scores. These were removed. The final standardisation and norming sample includes **2440** cases.

The poor representation of quintiles 4 and 5 children in some languages will affect findings. Language and quintile are confounded.

First, the distribution of total scores on the Language assessment is reported. Item-level scores are the *percentage of correct responses* to trials comprising test items (PC scores). Test scores are calculated based on these percentage scores, yielding a decimal scale ranging from 0 to 1. The histogram of total PC scores across the sample is presented in Figure 1, and descriptive statistics describing the distribution's range, central tendency, and shape are presented in Table 3.

Figure 1. ELOM-R Mathematics (v1) Standardisation Sample Mean Percent Correct Score Distribution

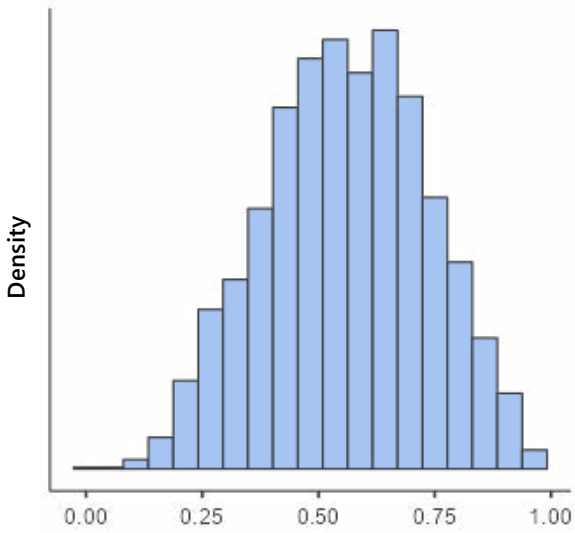


Table 3. ELOM-R Mathematics (v1) Sample for Standardisation and Norms

N	MISSING	MEAN	MEDIAN	SD	MINIMUM	MAXIMUM
2440	0	0.559	0.560	0.174	0.026	0.991

SKEWNESS		KURTOSIS	
SKEWNESS	SE	KURTOSIS	SE
-0.083	0.050	-0.513	0.099

PC scores on the Mathematics assessment appear normally and generally distributed on the total score histogram. The skewness value is both small and statistically nonsignificant, and the difference between mean and median is negligible, indicating the distribution is symmetrical.

ELOM-R MATHEMATICS (V1) STANDARDISATION SAMPLE SCHOOL QUINTILE DISTRIBUTIONS

As scores are normalised across South Africa's diverse population, language group and socioeconomic status (SES) are reported. While both group designations are important to consider, as previously noted, they are heavily confounded in South Africa.

The school quintile composition of each language group is reported in Figure 2, to provide context for consideration of confounding effects. SES is operationalised in terms of the quintiles assigned to the schools from which children were sourced. These are further categorised into schools that do not require the payment of fees (quintiles 1, 2, and 3), and those that do (quintiles 4 and 5).

Figure 2. ELOM-R Language (V1) Standardisation Sample School Quintile Distribution

Fee-paying schools predominated for the Afrikaans cohort alone, with comparable proportions of fee-paying and non-fee-paying schools in the English and isiZulu samples. Fee-paying isiXhosa and Sesotho schools are outnumbered by non-paying schools, while the proportion of Sepedi, Setswana, and Tshivenda schools paying fees is negligible. Sample school quintile composition is reported in Table 4.

Table 4. ELOM-R Mathematics (v1): Quintile Frequencies by Language

SCHOOL QUINTILE	AFRIKAANS	ENGLISH	SESOTHO	SEPEDI	SETSWANA	TSHIVENDA	ISIXHOSA	ISIZULU
1	84	14	68	218	240	98	23	43
2	84	33	63	13	0	63	74	56
3	38	118	75	23	21	109	101	61
4	141	48	46	16	8	20	57	82
5	101	69	35	16	7	0	35	39
Not Paying Fees (Q 1 – 3)	206	165	206	254	261	270	198	160
Paying Fees (Q 4 & 5)	242	117	81	32	15	20	92	121

**Modal values indicated in red text*

Table 4 reveals very different school quintile distributions across the language groups. Sepedi, Setswana, and Tshivenda fee-paying schools are underrepresented, and SES effects are likely to influence these cohorts heavily. The quintile frequencies suggest that the Sesotho cohort may be less affected than Sepedi or Setswana, as they possess far greater numbers of quintile 2 and 3 schools. Subsamples for paying and non-paying schools for all other language groups appear reasonably well populated.

PSYCHOMETRIC PROPERTIES OF THE ELOM-R LANGUAGE (V1) STANDARDISATION SAMPLE

RELIABILITY

Reliability testing procedures were taken to assess whether the ELOM-R (v1) Language items consistently measure language abilities defined in the DBE CAPS for Grade R across all the subsamples included in the overall norm. The reliability of the assessment was tested using McDonald's omega (ω), which assesses the internal consistency of assessment scores. Results are presented in Table 5.

Table 5. ELOM-R Mathematics (v1) Reliability Statistics

	Item-rest correlation	ω
ELOM-R Mathematics (V1) Scale		**0.864**
When the item is excluded...		
1. Count forwards to 20	0.400	0.860
2. Count backwards from 10	0.586	0.853
3. Counting from a given number	0.609	0.851
4. Skip counting in twos to 10	0.448	0.858
5. Count with 1:1 correspondence	0.394	0.860
6. Number order	0.609	0.851
7. Number recognition	0.563	0.853
8. Subitise to 5	0.574	0.853
9. Knowledge of ordinal numbers	0.525	0.855
10. Compare two collections of objects	0.318	0.863
11. Show a collection without counting	0.399	0.860
12. Solving addition and subtraction problems	0.561	0.853
13. Solving sharing and grouping problems	0.364	0.861
14. Shape and space construction	0.418	0.859
15. Sorting and grouping	0.389	0.860
16. Shape identification and understanding	0.571	0.853
17. Pattern extension	0.421	0.859
18. Pattern completion	0.323	0.863

The ELOM-R Mathematics (v1) Assessment demonstrates a very acceptable level of reliability **(ω = 0.864)**. No items produce sub-threshold item-rest correlations ($r > 0.3$) or detract from scale reliability (ω when item removed < 0.864).

The ELOM-R (v1) assessment can be considered a reliable measure within the norm group.
A confirmatory factor model is fitted to the norm sample to establish construct validity.

CONFIRMATORY FACTOR ANALYSIS (CFA)

A unidimensional factor model was specified in which all items contribute towards the same underlying Mathematics construct. Fit statistics in Table 6 describe the fit of this model to the observed data. Factor loadings of individual items to the single factor are evaluated to assess potential misfit at the item level. The tables below show that Model fit statistics (RMSEA < 0.05, CFI = 0.921, TLI = 0.910) and factor loadings ($\lambda > 0.3$, $p < .001$) are all acceptable, supporting construct validity of the Mathematics assessment.

Table 6. ELOM-R Mathematics (v1) CFA Model Fit

χ^2	df	P	CFI	TLI	RMSEA	Lower CI	Upper CI
920.26	135	< .001	0.921	0.910	0.049	0.046	0.052

Table 7 reports CFA model loadings using percent correct scores for each item. It will be evident that all loadings exceed the criterion ($\lambda > 0.3$).

Table 7. ELOM-R Mathematics (V1) CFA Model Item Factor Loadings (% Correct)

Item	Estimate	SE	Z	P	λ
1. Count forwards to 20	0.103	0.005	20.564	< .001	0.423
2. Count backwards from 10	0.284	0.009	33.143	< .001	0.636
3. Counting from a given number	0.282	0.008	34.649	< .001	0.657
4. Skip counting in twos to 10	0.208	0.009	23.682	< .001	0.479
5. Count with 1:1 correspondence	0.131	0.006	20.573	< .001	0.423
6. Number order	0.256	0.007	35.525	< .001	0.670
7. Number recognition	0.17	0.005	32.099	< .001	0.619
8. Subitise to 5	0.18	0.006	32.125	< .001	0.619
9. Knowledge of ordinal Numbers	0.162	0.006	29.176	< .001	0.573
10. Compare two collections of objects	0.066	0.004	16.331	< .001	0.342
11. Show a collection without counting	0.126	0.006	21.297	< .001	0.436
12. Solving addition and subtraction problems	0.19	0.006	30.543	< .001	0.596
13. Solving sharing and grouping problems	0.1	0.005	18.79	< .001	0.390
14. Shape and space construction (copy shape from models)	0.128	0.006	22	< .001	0.449
15. Sorting & Grouping	0.094	0.005	19.981	< .001	0.412
16. Shape identification and understanding	0.15	0.005	31.668	< .001	0.612
17. Pattern extension	0.173	0.008	22.051	< .001	0.450
18. Pattern completion	0.093	0.006	16.286	< .001	0.341

The construct validity and reliability (internal consistency) of the ELOM-R Mathematics (v1) Assessment is established.

Standardisation

As the ELOM-R Mathematics (v1) Assessment was designed to test the achievement of children exiting Grade R / entering Grade 1 across a highly diverse population, it is important to establish clear, meaningful score distributions. This was achieved through normalisation and standardisation techniques (Cohen et al., 1996[2]; (Kline, 2000[3]).

Normalisation **involves transforming raw scores into standard (Z-scores) such that they are:**
a) centred on 0 according to the population mean, and
b) scaled according to the spread (standard deviation) of data around the mean.

This allows scores across assessments and groups to be compared according to their distribution-relative distance from the mean.

Percentile ranking is another standardisation procedure that involves transforming raw scores to represent an individual's performance relative to typical performance on the assessment. For a given raw score, its percentile-ranked equivalent represents the proportion of the raw score distribution that falls equal to or below it.

A standardised score distribution has been derived, allowing for population-referenced, standardised scores to be calculated.

As the purpose of this assessment is to evaluate the attainment of educational standards applicable across quintile groups with known ability distribution differences, the observed median score differences are acceptable. Generally speaking, the norm tables indicate that children's scores are related to the quintile of their school.

Figure 3[4] presents the standardised distributions of both raw and normalised Mathematics scores. Raw scores across the full sample of respondents are transformed into Z-scores, and columns represent increments of Z, starting at -3 and ending at + 3. For each increment of Z (representing half standard deviation units), normed as well as raw percent correct (PC) scores corresponding to these distribution points are presented. Raw score counterparts to each Z interval are also presented by quintile, representing the scores corresponding to the indicated Z value within each school quintile- specific subsample. Median raw scores per quintile group in relation to the normalised distribution are indicated with dashed lines overlaid on the distribution curve, a key for which is presented under the standardisation table. Median score differences between quintiles across increments of Z are presented in vertical bars.

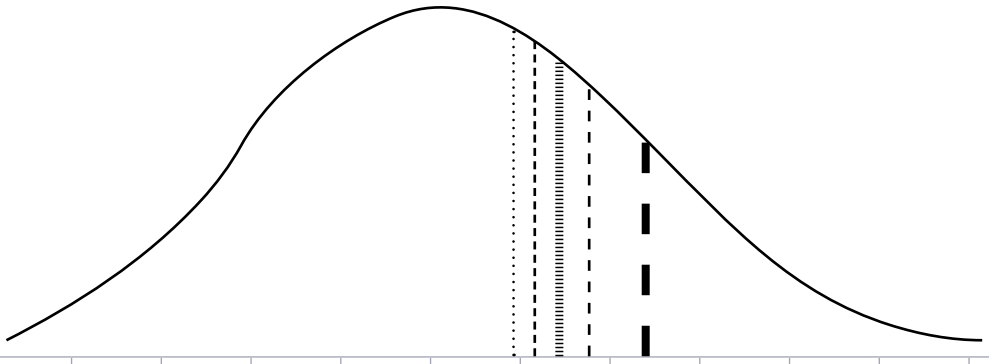
Table 8 provides standardised (percentile-ranked) raw scores, Raw Percentage Correct scores, and Z-normalised scores for reference purposes. These can be used to compare groups of children on the norms.

[2]Cohen, R. J., Swerdlik, M. E., & Phillips, S. M. (1996). Psychological testing and assessment: An introduction to tests and measurement, 3rd ed (pp. xxviii, 798). Mayfield Publishing Co.

[3]Kline, P. (2000). Handbook of Psychological Testing. London, United Kingdom: Routledge.

[4]For these calculations, each trial in each item is scored correct/incorrect. The proportion of trials correctly answered in each item is the Raw Percent Correct score for that item. The Raw Percent Correct score on the test as a whole reported in the Figure and the Table is the average item percent correct score for all items.

Figure 3. ELOM-R Mathematics (v1) Standardised Scores



	Z-Score	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3
	Norm Score (Percentile)	0	0.1	2	7.8	17	31.9	49.7	66.8	82.9	93.3	98.4	100	100
Raw Percentage Correct Scores	Norm Sample	4.0	12.6	21.3	30.0	38.6	47.2	55.9	64.6	73.2	81.8	90.6	99.1	100
	Quintile 1	1.7	9.9	18.1	26.4	34.6	42.8	51.1	59.3	67.5	75.8	84.0	92.3	100
	Quintile 2	0.5	9.4	18.2	27.1	35.9	44.8	53.7	62.5	71.4	80.2	89.1	97.9	100
	Quintile 3	6.3	14.7	23.1	31.5	39.9	48.3	56.7	65.1	73.5	81.9	90.3	98.7	100
	Quintile 4	11.7	19.5	27.3	35.1	42.9	50.7	58.5	66.3	74.1	81.8	89.6	97.4	100
	Quintile 5	16.7	25.0	33.3	41.6	49.9	58.2	66.5	74.8	83.1	91.4	99.7	100	100

Key: Quintile Median scores are indicated in lines on Figure 3.

Quintile median 1	51.1%	.....
Quintile median 2	53.7%	- - -

Table 8. ELOM-R Mathematics (v1) Norms

KEY	
RAW SCORE	The Raw (Percentage Correct) score on the test ranging 0 to 100. **Note:** Raw scores on each ELOM-R (v1) item have different scales. For example, a child can obtain a score from -1 to 20 on item 1 and a score from -1 to 10 on item 2. It is obvious that these two items have different scales. When a test is standardised, all scores must be converted to the same scale. For this reason, all ELOM-R (v1) item scores are converted to percentage correct total scores on the test ranging from 0-100.
Z	Z-scores range from -3 to +3 (in a normal distribution). The Z-score shows the distance of the raw percentage correct score from the mean of the distribution in standard deviation units either above (+) or below (-) the mean (in a normal distribution such as this, the mean and median have the same value). When two tests have Z-scores, these are then on the same scale and can be used in statistical analyses to compare scores on the two tests.
PERCENTILE	This value shows the percentage of the standardisation sample whose scores fall below the corresponding Raw Percentage Correct score. The percentile rank is the band of scores below the percentile.
COLOUR CODING	ELOM-R (v1) standards bands are shown on the table: ***Green: On Track: => 60th percentile*** ***Orange: Falling Behind: 32nd-59th percentile*** ***Red: Falling Far Behind: <32nd percentile***

INTERPRETATION OF ELOM-R MATHEMATICS (V1) RAW SCORES

Steps
1: Calculate the mean percentage correct raw score for your sample.
2: Use the norm table to look up the corresponding percentile and Z-score values for that score. This will tell you how your sample compares with the standardisation sample used to construct the ELOM-R norms V1.

Example:
*If your sample's mean Raw score = 47.3, it falls at the 32nd percentile of the standardised distribution. This indicates that your group scored in the same range as 32% of the standardisation sample who scored 47,3 or less on this test. The corresponding Z score in the table tells you how many standard deviations above (+) or below (-) your sample's score is from the **mean.** The corresponding Z-score in the table indicates how many standard deviations above (+) or below (-) your sample % correct score is from the **mean** of the standardisation sample, in this case, **0.50** standard deviations below the standardisation sample mean.*

FALLING FAR BEHIND			FALLING BEHIND			ON TRACK		
Raw Score	Z	Percentile	Raw Score	Z	Percentile	Raw Score	Z	Percentile
18.2	-2.18	1	47.3	-0.50	**32**	61.3	0.31	**60**
21.3	-2.00	2	47.8	-0.47	33	61.8	0.34	61
23.4	-1.88	3	48.3	-0.44	34	62.3	0.37	62
25.3	-1.77	4	48.8	-0.41	35	62.6	0.39	63
26.8	-1.68	5	49.3	-0.38	36	63.1	0.41	64
28.1	-1.61	6	49.7	-0.36	37	63.6	0.45	65
29.1	-1.55	7	50.4	-0.32	38	64.1	0.47	66
30.4	-1.48	8	50.9	-0.29	39	64.7	0.51	67
31.4	-1.42	9	51.4	-0.26	40	65.2	0.54	68
32.6	-1.35	10	51.8	-0.24	41	65.6	0.56	69
33.6	-1.29	11	52.2	-0.21	42	66.1	0.59	70
34.5	-1.24	12	52.9	-0.17	43	66.6	0.62	71
35.3	-1.19	13	53.2	-0.16	44	67.0	0.64	72

FALLING FAR BEHIND			FALLING BEHIND			ON TRACK		
Raw Score	Z	Percentile	Raw Score	Z	Percentile	Raw Score	Z	Percentile
36.4	-1.13	14	53.7	-0.13	45	67.6	0.67	73
37.2	-1.08	15	54.3	-0.09	46	68.1	0.70	74
38.0	-1.04	16	54.7	-0.07	47	68.6	0.73	75
38.6	-1.00	17	55.1	-0.05	48	69.0	0.76	76
39.2	-0.97	18	55.6	-0.02	49	69.5	0.78	77
40.1	-0.92	19	56.1	0.01	50	70.1	0.82	78
40.9	-0.87	20	56.6	0.04	51	70.5	0.84	79
41.5	-0.83	21	57.2	0.07	52	71.2	0.89	80
41.9	-0.81	22	57.6	0.10	53	71.9	0.92	81
42.5	-0.78	23	58.0	0.12	54	72.5	0.96	82
43.0	-0.75	24	58.4	0.14	55	73.3	1.00	83
43.5	-0.72	25	59.0	0.18	56	73.9	1.04	84
44.0	-0.69	26	59.6	0.21	57	74.6	1.08	85
44.6	-0.65	27	60.1	0.24	58	75.2	1.11	86
45.2	-0.62	28	60.6	0.27	59	76.1	1.16	87
45.8	-0.59	29				76.9	1.21	88
46.3	-0.56	30				77.9	1.27	89
46.9	-0.52	31				78.8	1.33	90
						79.8	1.38	91
						80.6	1.43	92
						81.4	1.47	93
						82.9	1.56	94
						84.1	1.63	95
						85.5	1.71	96
						87.1	1.80	97
						89.5	1.94	98
						92.6	2.12	99
						99.1	2.50	100