

Effects of Maturation on ELOM 4&5 Total and Domain Scores



HOW-TO: Understand and Use Data
to Drive Change

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When assessing the effects of an early learning programme (ELP) to improve child outcomes, it is important to separate the contribution of children's normal maturation due to ageing, from growth in their performance due to participation in the ELP.



Purpose of maturation effects: to separate the contribution of normal maturation (child ageing) from the effects of participation in an Early Learning Programme (ELP) when evaluating interventions to improve early learning outcomes.

The 'Maturation Effect' is defined as a **change in test performance attributable to ageing, independent of participation in an ELP.**

We use regression analysis, which assesses the relationship between the outcome variable (ELOM Total and Domain Scores) and one or more variables (maturation), to calculate the gains in ELOM Total and Domain scores resulting from maturation. The ELOM Total and the Domain regression coefficients are estimates of the amounts of gain per month due to maturation.

We ran regression analysis on several datasets,¹ outlined in the Appendix. We observed a high degree of convergence in the coefficients (i.e. they were all very similar) derived from different analyses, but only the 2016 dataset (highlighted in yellow) provides defensible maturation regression coefficients.

WHICH DATASET AND ANALYSIS TO USE TO SET MATURATION EFFECTS?

The regressions conducted on the Grade R 2016 ELOM Standardisation sample dataset, in which only gender is controlled, are the most appropriate for benchmarking ELOM 4&5 Total and Domain scores gains due to maturation. There are two reasons:

- 1. The data used to calculate a maturation effect should be derived from children who are not in ELPs, in order to exclude the possibility of improvement in performance due to the programme.** If this is not the case, the findings will be a function of both ageing and programme exposure (as noted by van der Berg in his analyses)². The 2016 sample meets this criterion. The children were assessed in January / February of Grade R, when they would have had minimal exposure to the curriculum.
- 2. The sample should be randomised.** While we do not know whether the 2016 sample was exposed to an ELP prior to their enrolment in Grade R, we have a random sample stratified by school quintile and covering the languages spoken by 70% of the population. Randomisation helps to minimise selection bias and gives an even chance of including children who would and who would not have had exposure to an ELP prior to Grade R.

All the other analyses have been conducted on samples that include children with known ELP or Grade R programme exposure rendering regressions conducted on these samples less defensible than those undertaken on the 2016 dataset.

ELOM 4&5 MATURATION GAINS FOR ELOM 4&5 TOTAL SCORE

Based on analyses conducted on the 2016 dataset, we recommend the use of **1.04 ELOM 4&5 Total score points as the benchmark for maturation gain per month**. Indeed any value in the range of 0.85 – 1.22 would be acceptable. This value is within the 95% confidence interval band, and has previously been recommended for use in web publications by the ELOM team following van der Berg's analysis cited above.

We note that one might deviate from 1.04 to lower values within the confidence interval range when estimating effect sizes (but not below 0.85). The lower the value of maturation, the larger the calculated programme effect size. Underestimation of maturation effects is preferable since setting it too high would offset the ability to detect programme effects. The same point applies to the domain coefficients.

ELOM 4&5 MATURATION GAINS FOR ELOM 4&5 DOMAIN SCORES

Inspection of the Appendix shows once again that the maturation gains across samples are highly comparable, with the exception of Domain 3 (Emergent Numeracy and Mathematics) for the Grade R 2016 ELOM Standardisation sample dataset. Again we recommend the coefficients found in analyses conducted on the 2016 dataset.

Note: all domain scores range from 0-20 standard score points. The total score ranges from 0 - 100 points.

BOX 1: RECOMMENDED MATURATION EFFECTS PER MONTH

DOMAIN	DOMAIN SCORE MATURATION EFFECT PER MONTH
Gross Motor Development (GMD)	0.23 (95% CI:0.17 - 0.28)
Fine Motor Coordination and Visual Motor Integration (FMC & VMI)	0.23 (95% CI: 0.19 - 0.28)
Emergent Numeracy and Mathematics (ENM)	0.12 (95% CI: 0.06 - 0.17)
Cognition and Executive Function (CEF)	0.25 (95% CI: 0.19 - 0.31)
Emergent Language and Literacy (ELL)	0.21 (95% CI: 0.15-0.28)
Total score	1.04 (95% CI:0.85 - 1.22)

More information on Effect Sizes and their application is available in the [How To Guide 1: Understanding Effect Sizes in Programme Evaluation and Research.](#)

APPLYING THE MATURATION EFFECT

For example, consider a child attending a programme who is 52 months old at baseline with a total ELOM score of 45.01 points. The same child is 62 months old at the endline with a total ELOM score of 63.05 points. There are two effects that have influenced the gain in total ELOM score: one due to maturation and one due to the programme. Exposure to the programme for 10 months would mean that the maturation effect is 10.4 points for the total score (1.04 x 10 months). The remainder would likely be due to programme exposure (63-45-10.4 = 7.64 points).

The size of the effect sizes measures the strength of relationships between variables. An increase of 7.64 points as is seen in this example translates to a medium effect size on the total ELOM score.

TABLE 1: PRACTICAL EXAMPLE OF MATURATION EFFECT ON ELOM SCORE

Baseline age	Baseline score (out of 100)	Endline age	Endline score (out of 100)	Months of exposure	Maturation effect	Total gain due to ELP	Effect size application (refer to ES paper)
52 months	45.01	62 months	63.05	10	$1.04 \times 10 = 10.4$	$63.05 - 45.01 - 10.4 = 7.64$ points	Medium (0.5 SD)

As another example, consider the same child's CEF score. If their baseline CEF score (out of 20) is 8.48 and the endline score is 11.95, the maturation gain is (0.25×10) 2.5 points. Therefore, exposure to the programme results in a gain of 0.96 points $(11.94 - 8.48 - 2.5)$, which is considered a small effect.

TABLE 2: PRACTICAL EXAMPLE OF MATURATION EFFECT ON CEF SCORE

Baseline age	Baseline score (out of 100)	Endline age	Endline score (out of 20)	Months of exposure	Maturation effect	Total gain due to ELP	Effect size application (refer to ES paper)
52 months	8.48	62 months	11.95	10	$0.25 \times 10 = 2.5$	$11.94 - 8.48 - 2.5 = 0.96$ points	Small

BOX 2: HOW TO CALCULATE DESCRIPTIVE PROGRAMME GAINS

$$\text{Programme gain} = \left(\text{Endline score} - \text{Baseline score} \right) - \text{Maturation effect (coefficient from box 2 x number of months)}$$

ENDNOTES

1 Acknowledgment: Analyses were conducted by Dr Servaas van der Berg (RESEP, University of Stellenbosch); Dr Zuhayr Kafaar (Psychology Department University of Stellenbosch) and Junita Henry at DataDrive2030.

2 Van der Berg, S. (2021). Estimating the impact of five early childhood development programmes against a counterfactual. Ilifa Labantwana and Research for Socio-Economic Policy at Stellenbosch University. <https://resep.sun.ac.za/wp-content/uploads/2021/11/Estimating-the-impact-of-five-early-childhood-development-programmes-against-a-counterfactual-V06.pdf>



The How-To: Understand and Use Data to Drive Change offer direction for monitoring, evaluation and research. All How-To Guides in the series can be used independently of each other. More information on the ELOM data tools and data sets, as well as the full suite of How-To Guides is available on <https://datadrive2030.co.za/>.

APPENDIX: EFFECTS OF MATURATION ON ELOM 4&5 PERFORMANCE – A COMPARISON OF UNSTANDARDISED REGRESSION COEFFICIENTS³ USING DIFFERENT DATASETS

ELOM 4&5	A) Grade R 2016 & 2019, ELPO 2018 (BASELINE) and Thrive by Five 2021*		B) Grade R 2016 & 2019, ELPO 2018 (BASELINE) and Thrive by Five 2021**		C) Grade R 2016 ELOM Standardisation sample*		D) Grade R 2016 ELOM Standardisation sample **		E) Thrive by Five 2021 only **		F) Thrive by Five 2021***	
	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI
Total	1.09	(1.03 - 1.14)	1.12	(1.06 - 1.17)	0.92	(0.74 - 1.11)	1.04	(0.85 - 1.22)	1.23	(1.09 - 1.37)	1.26	(1.12 - 1.40)
GMD	0.21	(0.19 - 0.22)	0.2	(0.19 - 0.22)	0.21	(0.15 - 0.27)	0.23	(0.17 - 0.28)	0.25	(0.22 - 0.29)	0.25	(0.21 - 0.29)
FMC & VMI	0.32	(0.30 - 0.33)	0.32	(0.31 - 0.34)	0.23	(0.19 - 0.28)	0.23	(0.19 - 0.28)	0.27	(0.24 - 0.31)	0.28	(0.24 - 0.31)
ENM	0.21	(0.19 - 0.22)	0.21	(0.20 - 0.23)	0.11	(0.05 - 0.17)	0.12	(0.06 - 0.17)	0.25	(0.21 - 0.29)	0.26	(0.22 - 0.30)
CEF	0.22	(0.20 - 0.24)	0.23	(0.22 - 0.25)	0.22	(0.16 - 0.28)	0.25	(0.19 - 0.31)	0.24	(0.19 - 0.28)	0.24	(0.20 - 0.28)
ELL	0.13	(0.11 - 0.15)	0.14	(0.12 - 0.16)	0.15	(0.09 - 0.21)	0.21	(0.15 - 0.28)	0.21	(0.17 - 0.26)	0.22	(0.17 - 0.26)
n	8,684		8,648		1,243		1,243		5,222		5,009	

Regressions followed an Ordinary Least Squares model. We used the relevant ELOM score as the dependent variable, age as the independent variable (the coefficient of interest), and controlled for gender and other relevant factors where appropriate. The asterisks indicate which variables were controlled for.

*Controlling for the effect of gender and school quintile;

** Controlling for the effect of gender only;

*** Controlling for the effect of gender and fee-level band

(See here for more information: <https://datadrive2030.co.za/resources/child-learning-outcomes-by-elp-fee-levels/>)

As it is a reliable variable known to influence ELOM scores, gender is controlled in all the analyses reported here. Due to the unreliability of the school quintile as a measure of socio-economic status in preschool children (particularly when the child is not in Grade R) and the various ways it might be interpreted, our view is that it is preferable that the quintile not be used as a control in the regressions.

All data is available at the DataFirst open data portal: <https://www.datafirst.uct.ac.za>

³ Unstandardised regression coefficients are gains in months.