CHAPTER 7: BUILDING LEARNER- AND SCHOOL-LEVEL MODELS WITH HLM

"You don't have to burn books to destroy a culture. Just get people to stop reading them"

Ray Bradbury

This research seeks to investigate the factors within the learners' background, for instance motivation to read, language skills and home environment that affect performance in reading literacy. It also seeks to uncover the extent to which factors associated with the school and classroom environments affect reading literacy performance. Also of importance is ascertaining how these relationships between factors differ or remain constant across the 11 official languages in South Africa, at least in light of the five language groupings.

For the purposes of answering these questions, Hierarchical Linear Modelling (HLM) was used. In Chapter 5 a detailed description was provided of HLM. The aim of using HLM is to establish the relationships between one or more explanatory variables obtained from items in the PIRLS 2006 contextual questionnaires on learner and school-level and the outcome variables in the form of reading achievement scores for the different language groupings.

The remainder of this chapter will examine the extent of variation between language groupings as basis for further analysis (section 7.1). Section 7.2 is dedicated to the learner-level model, outlining the factors associated with it as taken from the components of Creemers' Comprehensive Model of Educational Effectiveness and the corresponding variables as taken from the PIRLS 2006 learner and parent questionnaires. Similar descriptions of the school-level model, outlining the factors and their associated variables that were obtained from Grade 5 learners' teachers and school principals are presented in section 7.3. Explanations of how the scales for each factor were constructed and how HLM 6 was utilized in testing the two level model are presented throughout sections 7.2, 7.3 and 7.4.

7.1. VARIATION BETWEEN LANGUAGE GROUPINGS

Chapter 6 presented results of Grade 5 learners' performance on the PIRLS 2006 achievement tests (in reference to sub-question 1) for each of the 11 official languages. Table 7.1 (below) shows the average achievement scores per language:

Table 7.1: Average Grade 5 Achievement Score per Language

Language	N	% of PIRLS 2006 Sample	Average Achievement Score	SE
Afrikaans	1 678	11.5	415.7	12.0
English	2 793	19.1	398.0	17.1
IsiNdebele	798	5.5	238.6	12.2
IsiXhosa	1 470	10	215.0	7.6
IsiZulu	1 733	11.8	262.8	5.9
Sepedi	1 349	9.2	243.1	5.9
Sesotho	959	6.5	288.6	7.6
Setswana	1 055	7.2	288.1	12.1
Siswati	1 147	7.8	248.9	16.0
Tshivenda	784	5.3	262.1	15.0
Xitsonga	891	6.1	277.6	10.6

For the purposes of building multi-level models more effectively, it was decided not to analyze data individually for each of the 11 official languages. It has to be borne in mind that 11 official languages imply that analyses would have to be repeated and replicated 11 times over, with a chance that, due to small sample size, the languages spoken by less than 5% of the South African population (namely isiNdebele, Siswati, Tshivenda and Xitsonga) would be too small to permit pertinent specific insights from the analyses. To streamline this process, the PIRLS 2006 data was reduced and recoded into five language groupings, namely Afrikaans, English and Tshivenda as lone-standing language groupings,

followed by the Nguni languages (consisting of isiNdebele, isiXhosa, isiZulu, Siswati and Xitsonga), and the Sotho languages (consisting of Sepedi, Sesotho and Setswana). It will be noted that the Tshivenda sample of learners is very small. It might be argued that this language should be collapsed into one of the other language groupings, but because of its linguistic uniqueness, Tshivenda will be handled as a separate language grouping, in spite of its small sample size.

Average achievement scores for these language groupings are presented in Table 7.2:

Table 7.2: Average Grade 5 Achievement Score per Language Grouping

Language Grouping	N	% of the PIRLS 2006 Sample	Average Achievement Score	SE
Afrikaans	1 678	11.5	415.7	12.0
English	2 793	19.1	398.0	17.1
Nguni	6 039	41.2	243.3	4.4
Sotho	3 363	22.9	267.1	5.2
Tshivenda	784	5.3	262.1	15.0

The patterns of average achievement scores remain very similar between individual languages, and when grouped together into language groupings. Similar to the individual language analysis, Afrikaans and English Grade 5 learners outperformed learners from African languages, with a substantial drop in achievement for learners from Sotho, Tshivenda and then Nguni language groupings.

Due to the differences in average achievement scores between language groupings, the assumption is that variation will exist between different groupings of learners, in this case particularly based on language. Table 7.3 (below) indicates the variance between language groupings. Variance was computed using the Statistical Package for Social Sciences (SPSS) software.

Table 7.3: Variance Across Language Groupings

Language Grouping	N	Un-weighted Variance	Weighted Variance (Total Student Weight)
Afrikaans	1 678	16 052.2	17 027.5
English	2 793	21 925. 7	24 012.1
Nguni	6 039	8 813.2	9 386.4
Sotho	3 363	8 916.9	9 021.1
Tshivenda	784	9 761.4	9 291.6

Previous studies, for example Howie (2002), mirror the extreme variance and as here presented in Table 7.3, across language groupings. South African classrooms are characterized by large variation, rendering any generalizations difficult within such heterogeneous groups of learners. Intuitively, for example, one might be inclined to think that the group of Afrikaans Grade 5 learners should form a fairly homogenous group of white, Afrikaans first language speakers. However, it has to be kept in mind that the group of Afrikaans learners in this sample is also made up of learners who speak Afrikaans as a second language and may therefore include learners from Coloured and Black communities, who may be substantially less advantaged. This same pattern is of relevance to the other language groupings as well, where very little homogeneity exists within groups.

7.2. BUILDING THE LEARNER-LEVEL MODEL

Learner-level factors were identified from Creemers' Comprehensive Model of Educational Effectiveness and are expected to have an influence on reading literacy achievement. Factors that are associated with reading achievement on learner-level are time, opportunities used to read, motivation to read, social background and basic skills related to the ability to use language. For each of these factors, a number of variables have been identified and selected for analysis from the PIRLS 2006 learner and parent questionnaires.

It has to be kept in mind that not all of the variables from the contextual questionnaires will be used in building the learner-level model. Rather, only variables have been selected in accordance with the factors as outlined by Creemers, so in this way, a theoretical point of departure serves as justification for including and excluding some available variables in the model. By aggregating many or all the variables from the questionnaires, one allows the data and its artifacts to guide the analyses, instead of grounding the analyses in a firm theoretical underpinning. Raudenbush and Bryk (2002) also warn against an approach that includes all available variables in the model and then only deletes those variables of apparently little significance in the initial analyses. In taking this shotgun approach, the variation can be partitioned into many small segments, none of which might appear to have statistical significance.

The limitations of choosing only a theoretical model as a source for choosing variables for inclusion in the analyses may be a risk. Relevant sources of variation may not be represented in the model and might be overlooked. Despite this risk, a theoretical route was taken to investigate how variables that were operationalised in the data could be combined in clusters or factors. The decision to be made was then whether these clusters could be interpreted in terms of the concepts from Creemers' model or whether new concepts would be provided that were not yet represented in the chosen model. In this way, evidence was sought and established for the validity and adequacy of Creemers' model as bearing the closest conceptual resemblance for this study's research problem.

7.2.1. Variables Included in the Learner-level Model

Items in the PIRLS 2006 Learner and Parent questionnaires took the form of Likert scale questions, with each question stem followed by a number of options or statements to be responded to. Table 7.4 provides the factors as taken from Creemers' model, and the corresponding variables (as taken from the PIRLS 2006 Learner and Parent questionnaires) that are related to each of Creemers'

model. A description of the variables that have been selected for building a learner-level model is also provided.

Table 7.4: Factors and Variables Included in the Learner-Level Model

Factor	Variable Name	Variable Description
Time	asbgtoc1-7	Frequency of reading related activities outside of school
	asbgrto1-10	Frequency of specific reading activities outside of school
	asbgtsp1-5	Time spent engaging in activities outside of school on a normal school day
	asbgrht	Time spent on reading homework
	asbhtsoh*[11]	Time spent on reading homework as reported by parents
	asbhread*	Parents' time spent on reading related activities
Opportunity Used	asbgthc1-6	Frequency of reading related activities in school
	asbgafr1-4	Types of reading activities learners are afforded after reading
	asbghwrd	Frequency of reading homework
	asbgboff	Opportunities to take out books from the library
	asbhha1-11*	Opportunities used by parents/caregivers to engage the child in pre literacy activities
	asbhdot1-10*	Opportunities used by parents/caregivers to engage the child in reading related activities
	asbhrre*	Opportunities parents use to read for their own enjoyment
Motivation	asbgrst1-6	Attitudes about reading
	asbgrd1-7	Self-perceptions of reading abilities
	asbhstm1-5*	Parents' attitudes towards reading
Basic Skills (Language)	asbglngh	Frequency of speaking the language of the test at home
	asbhactl*	Language parents engage child in when doing reading activities
Social Background	asbgbook	Number of books in the home
	asbgta1-17	Resources in the home e.g. running water, electricity, television
	asbhchbk*	Number of children's books in the home

[11] *Denotes variables taken from the PIRLS 2006 Parent Questionnaire. All other variables are taken from the PIRLS 2006 Learner Questionnaire.

	asbhledf*	The highest level of education completed by the child's father
	asbhledm*	The highest level of education completed by the child's mother

7.2.2. Constructing Learner-level Scales From the PIRLS 2006 Learner and Parent Questionnaire Items

Table 7.4 has indicated that a selected number of items from the PIRLS 2006 Learner and Parent questionnaires were chosen as possible predictors of reading outcomes at the learner-level in accordance with Creemers' Model of Educational Effectiveness.

In order for multi-level models to be built, the individual questionnaire items had to be re-constructed into scales that corresponded to the factors measured by Creemers. The first step in this process was to aggregate all variables with more than one response option (as selected form the PIRLS 2006 questionnaires) to create a single composite scale per Creemers factor.

Principal component factor analysis was performed for each cluster of variables within the data scales corresponding to Creemers' model. The components were un-rotated and in all cases, initial extraction resulted in the extraction of two components. Table 7.5 (below) shows the results of the factor analysis for scales constructed from the PIRLS 2006 Learner Questionnaire:

Table 7.5: Factor Extraction with Learner-Level Variables from the Learner Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Component Score
Time	asbgtoc1-7	Frequency of reading related activities outside of school	Scaletoc	.128
	asbgrto1-10	Frequency of specific reading activities outside of school	Scalerto	.797
	asbgtsp1-5	Time spent engaging in activities outside of school on a normal school day	Scalegtsp	.200
	asbgrht	Time spent on reading homework	asbgrht	-.307
Opportunity Used	asbgthc1-6	Frequency of reading related activities in school	Scalethc	.045
	asbgafr1-4	Types of reading activities learners are afforded after reading	Scalegafr	.046
	asbghwrd	Frequency of reading homework	asbghwrd	-.032
	asbgboff	Opportunities to take out books from the library	asbgboff	.988
Motivation	asbgrst1-6	Attitudes about reading	Scalegrst	.894
	asbgrd1-7	Self-perceptions of reading abilities	Scalegrd	.878
Basic Skills (Language)	asbglngh	Frequency of speaking the language of the test at home	asbglngh	Removed from model
Social Background	asbgbook	Number of books in the home	asbgbook	.998
	asbgta1-17	Resources in the home e.g. running water, electricity, television	Scaleta	-.008

Table 7.6 (below) shows the results for the factor analysis on the learner-level variables taken from the PIRLS 2006 Parent Questionnaire:

Table 7.6: Factor Extraction with Parent-Level Variables from the Parent Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Compo-nent Score
Time	asbhtsoh	Time spent on reading homework as reported by parents	asbhtsoh	.666
	asbhread	Parents' time spent on reading related activities	asbhread	.666
Opportunity Used	asbhha1-11	Opportunities used by parents/caregivers to engage the child in pre literacy activities	Scalehha	.483
	asbhdot1-10	Opportunities used by parents/caregivers to engage the child in reading related activities	Scaledot	.498
	asbhrre	Opportunities parents use to read for their own enjoyment	asbhrre	.355
Motivation	asbhstm1-5	Parents' attitudes towards reading	asbhstm1-5	Removed from model
Basic Skills (Language)	asbhactl	Language parents engage child in when doing reading activities	asbhactl	Removed from model
Social Background	asbhchbk	Number of children's books in the home	asbhchbk	.301
	asbhledf	The highest level of education completed by the child's father	asbhledf	.493
	asbhledm	The highest level of education completed by the child's mother	asbhledm	.494

Information contained in Table 7.5 and 7.6 (above) indicates new names for some variables, while recording the original variable names for others. Only composite scores (and new scale variables) need new names. Factors with only a single item have unchanged names in the new data set with fewer explanatory variables.

It should also be noted that component scores are not provided for Motivation in Table 7.6 or Basic Skills (Language) in both Tables 7.5 and 7.6. Items related to 'Motivation' were removed as indicators, because these items were found upon closer inspection rather than being indicative of parent motivation to read, are

more closely related to parental attitudes towards reading. No other suitable replacement items could be found for this motivational factor, a decision was made to remove it from the theoretical model for the data analysis

Basic Skills (Language) have no component scores for either table, because the single candidate item each case was found on closer inspection not to be indicative of basic skills of either learner or parent. This component was also removed from the theoretical model for data analysis.

The initial principal component factor analysis resulted in two components being extracted for each of the scales constructed to measure factors of Creemers' model. A number of negative component scores were also evident on a number of items. The composite scales and items with only one response option were saved as standardized z-scores. Standardized scores would allow for variance to be comparable across variables.

The procedure of conducting a principal component analysis was now repeated for each variable, but by making use of the standardized score and saving the factor score in the data-set. Tables 7.7 and 7.8 (below) provide details of components scores for the analyses at learner-level:

Table 7.7: Factor Extraction with Standardized Learner-Level Scores from the Learner Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Compo-nent Score
Time	asbgtoc1-7	Frequency of reading related activities outside of school	ZScore (Scaletoc)	.711
	asbgrto1-10	Frequency of specific reading activities outside of school	ZScore (Scalerto)	.744
	asbgtsp1-5	Time spent engaging in activities outside of school on a normal school day	ZScore (Scalegtsp)	.867
	asbgrht	Time spent on reading homework	asbgrht	Removed from model
Opportunity Used	asbgthc1-6	Frequency of reading related activities in school	ZScore (Scalethc)	.881
	asbgafr1-4	Types of reading activities learners are afforded after reading	ZScore (Scalegafr)	.881
	asbghwrd	Frequency of reading homework	asbghwrd	Removed from model
	asbgboff	Opportunities to take out books from the library	asbgboff	Removed from model
Motivation	asbgrst1-6	Attitudes about reading	Scalegrst	Removed from model
	asbgrd1-7	Self-perceptions of reading abilities	Scalegrd	Removed from model
Basic Skills (Language)	asbglngh	Frequency of speaking the language of the test at home	asbglngh	Removed from model
Social Background	asbgbook	Number of books in the home	ZScore (asbgbook)	.639
	asbgta1-17	Resources in the home e.g. running water, electricity, television	ZScore (Scaleta)	.639

Variance was computed for each of the factors from Creemers' model separately. In Table 7.7 (above), the factor 'Time' accounts for 61.4% of the variance, while the factor 'Opportunity used' explains 77.6% of the variance in reading achievement at learner-level. The factor 'Social background', which is a composite of the quantum of books in the home and indicators of possessions, explain 61.2% of the variance.

Table 7.8 (below) indicates the standardized component extraction of learner-level variables taken from the Parent Questionnaire:

Table 7.8: Factor Extraction with Standardized Learner-Level Scores from the Parent Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Component Score
Time	asbhtsoh	Time spent on reading homework as reported by parents	ZScore(asbhtsoh)	.751
	asbhread	Parents' time spent on reading related activities	ZScore(asbhread)	.751
Opportunity Used	asbhha1-11	Opportunities used by parents/caregivers to engage the child in pre literacy activities	ZScore(Scalehha)	.795
	asbhdot1-10	Opportunities used by parents/caregivers to engage the child in reading related activities	ZScore(Scaledot)	.820
	asbhrre	Opportunities parents use to read for their own enjoyment	ZScore(asbhrre)	.585
Motivation	asbhstm1-5	Parents' attitudes towards reading	asbhstm1-5	Removed from model
Basic Skills (Language)	asbhactl	Language parents engage child in when doing reading activities	asbhactl	Removed from model
Social Background	asbhchbk	Number of children's books in the home	ZScore(asbhchbk)	.522
	asbhledf	The highest level of education completed by the child's father	ZScore(asbhledf)	.853
	asbhledm	The highest level of education completed by the child's mother	ZScore(asbhledm)	.855

Similar to Table 7.7, variance was computed for each of the factors as measured by Creemers' model separately. In Table 7.8, the factor 'Time' accounts for 56.4% of the variance in reading achievement scores, while

'Opportunity used' explains 54.9% of variance. 'Social background', as measured by parents' level of education and availability of specifically children's books in the home accounts for 57.7% of variance.

7.3. BUILDING THE SCHOOL-LEVEL MODEL

For the purposes of this study, a two-level model is suggested, with learner-level variables nested within school-level variables. The PIRLS 2006 sample was drawn so that only single intact classrooms within schools were selected, thereby making them inextricably part of the school. Thus school and classroom-level variables are confounded together in one level, and variables at these levels cannot be separated from one another in the data.

7.3.1. Variables Included in the School-Level Model

The theoretical points of departure used as a framework for analysis and the procedures that guided the selection of variables for the school-level model are the same as those that were followed for the learner-level model. Table 7.9 illustrates the factors and PIRLS 2006 variables that have been selected for the school-level model in accordance with Creemers' model.

Table 7.9: Factors and Variables Included in the School-Level Model

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description
Educational Quality	acbgacu1-3	Emphasis school places on teaching specific language and literacy skills to learners in Grades 1-4
	acbgme1-12	Grade at which specific reading skills and strategies first receive major emphasis in instruction in the school
	acbgsi1-14	School's capacity to provide instruction affected by a shortage or inadequacy of specific issues
	atbgcstd*[12]	The number of learners in the class

[12] *Denotes variables taken from the PIRLS 2006 Teacher Questionnaire. All other variables are taken from the PIRLS 2006 School Questionnaire.

	atbgercn*	Provision for enrichment reading instruction
	atbglicr*	Availability of a library or reading corner in the classroom
	atbghwr1*	Frequency of assigning reading as part of homework (for any subject)
	atbgbhr1-8*	Teacher strategies if a learner begins to fall behind in reading
	atbgmsr 1-4*	Emphasis that is placed on specific sources to monitor learners' progress in reading
	atbgasp1-7*	Frequency of using specific tools to assess learners' performance in reading
Organizational Quality	acbgcoop	School's official policy statement related to promoting cooperation and collaboration among teachers
Time	acbgtac1-7	Percentage of principal's time that is devoted to specific activities
	acbgtach	The amount of hours per week spent on different activities
	acbgidy (ACBGZ003)	The amount of days per year the school is open for instruction
	atbgpac1-5*	Percentage of teachers' time per week in class with learners devoted to specific activities
	atbgacth*	The amount of time per week spent on English language instruction and/or activities with the learners
	atbgfrdh*	The amount of time that is explicitly for formal reading instruction
	atbghwr 2*	The amount of time learners are expected to spend on homework involving reading (for any subject)
	atbgrdjy*	Frequency of teacher reading for enjoyment
	acbgrii	Informal initiatives to encourage learners to read
	acbgma1-6	School's use of the specific materials in reading instructional programme for learners in Grades 1-4
Opportunity Used	acbgpro1-5 (ACBGZ049-053)	Frequency in providing specific services by the school for Grade 5 learners and/or their families
	atbgract*	Frequency teacher has reading instruction and/or reading activities with the learners
	atbgria1-9*	Frequency of using specific resources when doing reading activities/instruction

	atbgra1-10*	Frequency of doing specific activities when doing reading activities/instruction
	atbgdev1-7*	Frequency teacher requires of learners to engage in specific activities to help develop reading comprehension skills or strategies

7.3.2. Constructing School-Level Scales from the PIRLS 2006 School and Teacher Questionnaire Items

The procedures followed to construct scales for the learner-level variables were replicated to construct the school-level scales. Table 7.10 indicates the initial, un-rotated components that were extracted through principal factor analysis for the school-level variables as taken from the PIRLS 2006 School Questionnaire:

Table 7.10: Factor Extraction with School-Level Variables from the School Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Compo-nent Score
Educational Quality	acbgacu1-3	Emphasis school places on teaching specific language and literacy skills to learners in Grades 1-4	Scalegacu	.648
	acbgme1-12	Grade at which specific reading skills and strategies first receive major emphasis in instruction in the school	Scaleme	.764
	acbgsi1-14	School's capacity to provide instruction affected by a shortage or inadequacy of specific issues	Scalegsi	-.006
Organizational Quality	acbgcoop	School's official policy statement related to promoting cooperation and collaboration among teachers	acbgcoop	Removed from model
Time	acbgtac1-7	Percentage of principal's time that is devoted to specific activities	Scaletac	.904
	acbgtach	The amount of hours per week spent on different activities	acbgtach	.313
	acbgidy (ACBGZ003)	The amount of days per year the school is open for instruction	acbgidy (ACBGZ003)	-.243
	acbgrii	Informal initiatives to encourage learners to read	acbgrii	-.153

Opportunity Used	acbgpro1-5 (ACBGZ049-053)	Frequency in providing specific services by the school for Grade 5 learners and/or their families 9-053)	ScaleZ49	.763
	acbgma1-6	School's use of the specific materials in reading instructional programme for learners in Grades 1-4	Scalema	.763

As noted, the variable selected for the factor 'Organizational Quality' was removed from the theoretical model before the principal component analysis was conducted. Upon closer inspection, the item selected to serve as an indicator of organizational quality seems rather to be a measure of teacher cooperation. In the absence of other supporting items that could be used as indicators of the factor 'organizational quality', the item and factor were removed from the model.

Table 7.11 indicates the initial extraction of components of school-level variables that were selected from the PIRLS 2006 Teacher Questionnaire:

Table 7.11: Factor Extraction with School-Level Variables from the Teacher Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Compo-nent Score
Educational Quality	atbgcstd	The number of learners in the class	atbgcstd	.388
	atbgercn	Provision for enrichment reading instruction	atbgercn	.507
	atbglicr	Availability of a library or reading corner in the classroom	atbglicr	.566
	atbghwr1	Frequency of assigning reading as part of homework (for any subject)	atbghwr1	.103
	atbgbhr1-8	Teacher strategies if a learner begins to fall behind in reading	Scalebhr	.068
	atbgmsr 1-4	Emphasis that is placed on specific sources to monitor learners' progress in reading	Scalegmsr	.000
	atbgasp1-7	Frequency of using specific tools to assess learners' performance in reading	Scalegasp	-.186

Time	atbgpac1-5	Percentage of teachers' time per week in class with learners devoted to specific activities	Scalepac	-
	atbgacth	The amount of time per week spent on English language instruction and/or activities with the learners	atbgacth	-.012
	atbgfrdh	The amount of time that is explicitly for formal reading instruction	atbgfrdh	.170
	atbghwr 2	The amount of time learners are expected to spend on homework involving reading (for any subject)	atbghwr 2	.354
Opportunity Used	atbgrdjy	Frequency of teacher reading for enjoyment	atbgrdjy	-
	atbgract	Frequency teacher has reading instruction and/or reading activities with the learners	atbgract	.557
	atbgria1-9	Frequency of using specific resources when doing reading activities/instruction	Scalegria	.779
	atbgra1-10	Frequency of doing specific activities when doing reading activities/instruction	Scalegra	.842
	atbgdev1-7	Frequency teacher requires of learners to engage in specific activities to help develop reading comprehension skills or strategies	Scaledev	.814

The absence of component scores for two items can be seen in Table 7.11 (above). The variable named 'atbgpac' (the percentage of teachers' time per week in class with learners devoted to specific activities) was an item requesting teachers to indicate percentages of time spent on different classroom-related activities. The item was answered poorly and unreliably: though it instructed teachers to make the total reported time spent on activities as 100%, nonetheless many teachers did not comply with the instruction, resulting in unreliable responses often exceeding 100% in total.

The second variable for which a component score is absent ('atbgdjy' – the frequency of teacher reading for enjoyment) relates to teachers reports on time spent for their own enjoyment. Upon further reflection, the item is not regarded as a good indicator of reading outcomes at Grade 5, but rather, the item is regarded as a stronger indicator of teacher attitudes towards reading, so the decision was taken to remove it from the theoretical model for the data analysis.

The results of the initial factor extraction resulted in some negative component scores and the extraction of two components for each cluster of items that represent a factor as measured by Creemers' model. For this reason, the route followed with constructing the learner-level scales was replicated. School-level variables from PIRLS 2006 School and Teacher Questionnaires were saved as standardized scores, and factor scores to these were saved as new variables in the dataset. Table 7.12 shows the results of the principal component factor analysis with the standardized scores from the School Questionnaire items:

Table 7.12: Factor Extraction with Standardized School-Level Scores from the School Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Component Score
Educational Quality	acbgacu1-3	Emphasis school places on teaching specific language and literacy skills to learners in Grades 1-4	ZScore (Scalegacu)	.702
	acbgme1-12	Grade at which specific reading skills and strategies first receive major emphasis in instruction in the school	ZScore (Scaleme)	.702
	acbgsi1-14	School's capacity to provide instruction affected by a shortage or inadequacy of specific issues	acbgsi1-14	Removed from model
Time	acbgtac1-7	Percentage of principal's time that is devoted to specific activities	acbgtac1-7	Removed from model
	acbgtach	The amount of hours per week spent on different activities	acbgtach	Removed from model
	acbgidy (ACBGZ003)	The amount of days per year the school is open for instruction	ZScale (ACBGZ003)	.700
	acbgrii	Informal initiatives to encourage learners to read	ZScale (acbgrii)	.700
Opportunity Used	acbgpro1-5 (ACBGZ049-053)	Frequency in providing specific services by the school for Grade 5 learners and/or their families 9-053)	ScaleZ49	Removed from model
	acbgma1-6	School's use of the specific materials in reading instructional programme for learners in Grades 1-4	ZScale (Scalema)	.763

Table 7.12 indicates the removal of a further number of variables from the model. The variable named 'acbgsi' (the school's capacity to provide instruction affected by a shortage or inadequacy of specific issues) appears to be a

stronger indicator of resources than of educational quality. The removal of items 'acbgtac' (the percentage of principal's time that is devoted to specific activities) and 'acbgtach' (the number of hours per week spent on different activities) is based on grounds similar to those for the Teacher Questionnaire percentage item. The same question was posed to school principals, and was answered poorly and unreliably. Many school principals did not comply with the instruction, resulting in unreliable responses often exceeding 100% in total.

The removal of item 'ACBGZ049-ACBGZ053' (the frequency of provision of specific services by the school for Grade 5 learners and/or their families) is based on closer scrutiny of the item, which seems to be a stronger indicator of parent-school relations, and not necessarily the opportunity offered by schools to improve reading ability.

Separate variance computations per factor indicates that the factor 'educational quality' explains 50.7% of the variance, while 'time' explains 51% of the variance in the model.

Table 7.13 indicates the school-level component extraction based on standardized scores from the PIRLS 2006 Teacher Questionnaire:

Table 7.13: Factor Extraction with Standardized School-Level Scores from the Teacher Questionnaire

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	New Variable Name	Component Score
Educational Quality	atbgcstd	The number of learners in the class	atbgcstd	Removed
	atbgercn	Provision for enrichment reading instruction	atbgercn	Removed
	atbglicr	Availability of a library or reading corner in the classroom	atbglicr	Removed
	atbghwr1	Frequency of assigning reading as part of homework (for any subject)	atbghwr1	Removed
	atbgbhr1-8	Teacher strategies if a learner begins to fall behind in reading	ZScore (Scalegbhr)	.745
	atbgmsr 1-4	Emphasis that is placed on specific sources to monitor learners' progress in reading	ZScore (Scalegmsr)	.798
	atbgasp1-7	Frequency of using specific tools to assess learners' performance in reading	ZScale (Scalegasp)	.775
Time	atbgacth	The amount of time per week spent on English language instruction and/or activities with the learners	ZScore (atbgacth)	.493
	atbgfrdh	The amount of time that is explicitly for formal reading instruction	ZScore (atbgfrdh)	.539
	atbghwr 2	The amount of time learners are expected to spend on homework involving reading (for any subject)	ZScore (atbghwr2)	.264
	atbgract	Frequency teacher has reading instruction and/or reading activities with the learners	ZScore (atbgract)	-.232
Opportunity Used	atbgria1-9	Frequency of using specific resources when doing reading activities/instruction	ZScore (Scalegria)	.779
	atbgra1-10	Frequency of doing specific activities when doing reading activities/instruction	ZScore(Scalegra)	.842
	atbgdev1-7	Frequency teacher requires of learners to engage in specific activities to help develop reading comprehension skills or strategies	ZScore (Scaledev)	.814

Table 7.13 implies that the first four indicators of the factor referred to by Creemers as 'Educational Quality' has been removed from the model. In discussion with HLM experts[13], closer investigation of the items may be indicative of school resources, not of the provision of educational quality. Item 'atbgract' (the frequency a teacher has with reading instruction and/or reading activities with the learners) has also been removed from further analysis at school-level in light of its negative component score.

Variance in reading achievement accounted for by each of Creemers' factors was computed separately. The factor 'educational quality' explains 59.8% of the reading achievement score variance, with 'time' explaining 38% of the variance. The factor 'opportunity used' explains 66% of variance in the model.

7.4. SUMMARY OF MODELS TO BE USED IN HLM ANALYSIS

The construction of the explanatory scales which are to be used at the learner-level and school-level resulted in the inclusion of some PIRLS 2006 items in the model based on strong factor component scores. In some cases, items were removed due to negative factor component scores or based on decisions that items may theoretically not be as suitable in measuring one of the desired factors from the Creemers model.

Table 7.14 indicates the variables that have been included in measuring the factors 'time', 'opportunity used' and 'social background' at the learner-level:

[13] Prof Roel Bosker, Rijksuniversiteit Groningen, visited from 01-15 July 2009.

Table 7.14: Model Variables Included at the Learner-Level

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	PIRLS 2006 Questionnaire Source
Time	asbgtoc1-7	Frequency of reading related activities outside of school	Learner questionnaire
	asbgrto1-10	Frequency of specific reading activities outside of school	Learner questionnaire
	asbgtsp1-5	Time spent engaging in activities outside of school on a normal school day	Learner questionnaire
	asbhtsoh	Time spent on reading homework as reported by parents	Parent questionnaire
	asbhread	Parents' time spent on reading related activities	Parent questionnaire
Opportunity Used	asbgthc1-6	Frequency of reading related activities in school	Learner questionnaire
	asbgafr1-4	Types of reading activities learners are afforded after reading	Learner questionnaire
	asbhha1-11	Opportunities used by parents/caregivers to engage the child in pre literacy activities	Parent questionnaire
	asbhdot1-10	Opportunities used by parents/caregivers to engage the child in reading related activities	Parent questionnaire
	asbhrre	Opportunities parents use to read for their own enjoyment	Parent questionnaire
Social Background	asbgbook	Number of books in the home	Learner questionnaire
	asbgta1-17	Resources in the home e.g. running water, electricity, television	Learner questionnaire
	asbhchbk	Number of children's books in the home	Parent questionnaire
	asbhledf	The highest level of education completed by the child's father	Parent questionnaire
	asbhledm	The highest level of education completed by the child's mother	Parent questionnaire

Table 7.15 indicates the variables that have been included in measuring the factors 'time', 'opportunity used' and 'educational quality' at the school-level:

Table 7.15: Model Variables Included at the School-Level

Factor as Measured by Creemers' Model	PIRLS 2006 Variable Name	Variable Description	PIRLS 2006 Questionnaire Source
Educational Quality	acbgacu1-3	Emphasis school places on teaching specific language and literacy skills to learners in Grades 1-4	School questionnaire
	acbgme1-12	Grade at which specific reading skills and strategies first receive major emphasis in instruction in the school	School questionnaire
	atbgbhr1-8	Teacher strategies if a learner begins to fall behind in reading	Teacher questionnaire
	atbgmsr 1-4	Emphasis that is placed on specific sources to monitor learners' progress in reading	Teacher questionnaire
	atbgasp1-7	Frequency of using specific tools to assess learners' performance in reading	Teacher questionnaire
Time	acbgidy (ACBGZ003)	The amount of days per year the school is open for instruction	School questionnaire
	acbgrii	Informal initiatives to encourage learners to read	School questionnaire
	atbgacth	The amount of time per week spent on English language instruction and/or activities with the learners	Teacher questionnaire
	atbgfrdh	The amount of time that is explicitly for formal reading instruction	Teacher questionnaire
	atbghwr 2	The amount of time learners are expected to spend on homework involving reading (for any subject)	Teacher questionnaire
Opportunity Used	acbgma1-6	School's use of the specific materials in reading instructional programme for learners in Grades 1-4	School questionnaire
	atbgria1-9	Frequency of using specific resources when doing reading activities/instruction	Teacher questionnaire
	atbgra1-10	Frequency of doing specific activities when doing reading activities/instruction	Teacher questionnaire
	atbgdev1-7	Frequency teacher requires of learners to engage in specific activities to help develop reading comprehension skills or strategies	Teacher questionnaire

CHAPTER 8: HIERARCHICAL LINEAR MODEL RESULTS

"The world may be full of fourth-rate writers, but it is also full of fourth-rate readers"

Stan Barstow

This chapter will provide overall results for the two-level models at learner- and school-level for the PIRLS 2006 South African data, followed by the particular results for each of the language groupings separately. Research questions 3, 4 and 5, as outlined in Chapters 1 and 5 of this research, seek to investigate the factors related to the learners' backgrounds, for example motivation to read, language skills and home environment, that affect performance in reading literacy. Also of interest is the extent to which the school and classroom environments affect reading literacy performance, and the manner in which these relationships between factors and performance differ or remain constant across the country's 11 official languages (within the five language groupings for which test results are available).

For the purposes of answering the questions, Hierarchical Linear Modeling (HLM) was used to determine the strength of evidence for the effect of a number of explanatory variables at learner- and school-level on reading achievement as response or dependent variable, while controlling for language.

For the sake of clarity and the interpretation of results, a number of data considerations deserve mention here. Firstly, the PIRLS 2006 South African data was subject to many missing data values for some explanatory variables. These missing values were accounted for by imputing zeros, since the average of the factor score used as basis for the decision to include or exclude explanatory variables from the model, at each level, is zero. The imputation has the consequence of never allowing a missing value to be taken as an indicator of some explanatory use or effect. A second consideration pertains to the use of plausible values (as discussed in Chapter 5) when running analyses. In using HLM, each of the five response or achievement variables comprised of

plausible values which was used as an outcome variable. This strategy was an attempt to deal with the limitations of achievement data in contexts where learners answer very few items.

For the purposes of this results chapter, it is important to distinguish between two different meanings of the word 'significant' as it will be used in this chapter. Statistical significance implies the presence of a numerically discernible contrast or difference between summary statistics obtained from the data. Whether or not the discernible difference is important or consequential is a non-statistical issue, and for this study the judgment of educators and specialists will be relevant and appropriate. On the other hand, it also has to be kept in mind that important differences may exist within comparisons made from the data, but may fail to generate a signal of statistical significance. This lack of statistical significance in such circumstances might be attributed to the limited size of the data set as the size may not adequately compensate for its large internal variability of performance. The hope in this study is that the numbers of schools providing data may be sufficient to allow evidence for deeper insights into reading to emerge.

Lastly, for all the models, data was weighted using the Houseweight (HOUWGT)[14], which is a transformation of the total student weight (TOTWGT) and ensures that the weighted sample corresponds to the actual sample size and population structure in each country (Foy & Kennedy, 2008; Dalton & Provasnik, 2009).

In light of the research questions and the use of HLM, the remainder of this chapter will provide results for an overall South African model, which comprises only those variables at learner- and school-level which have been selected for the explanatory purposes of this study (described in Chapter 7 and presented here in section 8.1). Results for the overall model will be followed by results for two models for each language grouping that are presented separately for each

[14] HOUWGT is proportional to TOTWGT multiplied by the ratio of the sample size (n) divided by the sum of the weights over all learners in the grade.

of the five language groupings (section 8.2 to 8.6), first at learner-, then at school-level.

It will be noted that only one overall model is presented for this study, while models for each of the language groupings are separated at learner- and school-level. As a practical consideration, a single overall model presents an overall picture of the data first in as concise and clear manner as possible.

8.1. RESULTS FOR THE OVERALL SOUTH AFRICAN MODEL AT LEARNER- AND SCHOOL-LEVEL

Chapter 7 provided detailed information on the selection criteria and ultimate selection of variables for inclusion in the two-level models. For purposes of the overall model, all these selected variables were included at both learner- and school-level to explore an overall picture of the South African Grade 5 reading achievement landscape in light of the PIRLS 2006 data.

Results of the overall South African model are preceded by presenting a null (or empty) model. The null model (as also used by Shalabi, 2002, Howie, 2002 and described by Luke, 2004; Hox, 2002 and Heck & Thomas, 2000) has no explanatory variables and should provide the basic partition of the variability in the data between the learner- and school-level in the ensuing models. The null model can therefore be expressed as:

$$\beta 0 = \gamma 00 + U0$$

$\beta 0$ is the level 1 reference intercept, $\gamma 00$ is the mean value of the level-1 outcome across all level-2 units, and $U0$ is the deviation from the grand mean. Table 8.1 (below) shows the results of the overall null model:

Table 8.1: Estimation of the Variance Components for the Overall Null Model

Variables	Estimate	SE
Grand mean	307.3	8.0
Variance components:		
School-level	12 693.7	
Learner-level	7 290.2	

Table 8.1 (above) indicates the existence of significant differences between South African schools in reading literacy achievement. The between school variance for the null model is 42%[15] of the total variance. Based on the partition of this variability, an overall South African model, populated with explanatory variables, can be presented.

At school-level, school and classroom variables of *educational quality*, *time spent on reading activities* and *opportunities created for reading* are included in the model. *Educational quality* refers specifically to those activities undertaken by teachers in the classroom to teach, promote and engage learners in reading. *Time spent on reading* refers to the measurable aspects of actual time devoted to reading activities by the teacher and the school. *Opportunities created by teachers* at classroom-level and schools are those opportunities afforded to Grade 5 learners to engage in reading at school, variables related to the existence of *informal initiatives, the use of materials in school and the involvement of parents in school activities.*

At learner-level, variables concerning the learner and the parent include aspects similar to those included in the school-level model. *Time spent on reading, opportunities used for reading by learner and parent*, as well as *learner- and parent social background* are included in the model. Aspects at learner-level include learner *age and sex*, since these biographical variables have repeatedly been shown to be significant predictors of reading achievement (see Chapter 3).

[15] The percentage of explained variance for the null model was obtained as follows: 12 693.7-7 290.2/12 693.70 = 0.42 or 42% variance. This procedure was followed in computing variance for all models discussed in this chapter.

The overall South African learner-level and learner- and school-level model can be presented as:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(MSOCLP) + \gamma_{02}(AFR) + \gamma_{03}(NGU) + \gamma_{04}(SOTH) + \gamma_{05}(TSHI) + \gamma_{06}(QUALT) + \gamma_{07}(TIMET) + \gamma_{08}(OPPUSET) + \gamma_{09}(QUALEDS) + \gamma_{010}(TIMES) + \gamma_{011}(OPPORS) + u_0$$

$$\beta_1 = \gamma_{10}$$

$$\beta_2 = \gamma_{20}$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

In the level-1 model, explanatory variables for learners have been named as follows:

Table 8.2: Variable Naming Conventions for the Level-1 Model

Variable Name	Description
ITAGE	Age of the learner
ITSEX	Sex of the learner
TIMEL	Reading time spent by the learner
OPPUSEL	Reading opportunity used by the learner
TIMEPAR	Reading time spent by the parent
OPPAR	Reading opportunity used by the parent
SOCLP	Social background of the learner and parent
MISSLORP	Missing data for either parents or learners

In the level-2 model, explanatory variables have been named as follows:

Table 8.3: Variable Naming Conventions for the Level-2 Model

Variable Name	Description
MSOCLP	Socio-economic status of school as derived from learner and parent data
AFR	Afrikaans learners
NGU	Nguni learners
SOTH	Sotho learners
TSH	Tshivenda learners
QUALT	Quality of teachers
TIMET	Time spent by teachers on reading
OPPUSET	Reading opportunities used by teachers
QUALEDS	Educational quality of the school
TIMES	Time spent on reading by the school
OPPORS	Reading opportunities used by the school

The naming convention for variables remains the same for the purposes of all models to follow with ASRREA01 (reading achievement score) as dependent variable.

Table 8.4 (below) provides results for the overall South African model, one in which English was used as control language. Of all the official languages represented in the PIRLS 2006 sample, the English group of learners represents the most diverse group, including first, second and third language speakers. The intercept indicated provides a reference value for South African Grade 5 readers with an average English reading achievement score of 524.3 (SE=22.5) for this model. This intercept is arbitrary and is much higher than the average PIRLS 2006 assessment score for Grade 5 English learners of 400 (see Chapter 6). Because the intercept is affected by the coefficients and the explanatory variables in the model, it has to be kept in mind that the intercept is influenced by two aspects: firstly, it is a prediction of what reading achievement scores would have been had all responses to items for all learners been available. Secondly, it is influenced by the addition of coefficients or explanatory variables to the model.

All coefficients provided in Table 8.4 are therefore interpreted as changes from the reference. Every one point increase or decrease in explanatory variables results in a change determined by a coefficient reported in the table.

Table 8.4: Overall Final Model Results for the PIRLS 2006 South African Data

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	524.33	22.53	0.00
School and Classroom-Level				
MSOCLP	School socio-economic status	69.10	5.21	0.00
AFR	Afrikaans	-10.93	11.17	0.32
NGU	Nguni	-70.90	12.75	0.00
SOTH	Sotho	-68.00	11.80	0.00
TSH	Tshivenda	-73.51	15.80	0.00
QUALT	Teacher quality	11.87	5.66	0.03
TIMET	Teacher time spent on reading in class	1.09	5.34	0.83
OPPUSET	Reading opportunity created by teacher	-14.12	5.44	0.01
QUALEDS	School educational quality	6.80	3.65	0.06
TIMES	School time spent reading	8.90	4.03	0.02
OPPORS	Reading opportunity created by school	1.18	3.30	0.71
Learner-Level				
ITAGE	Learner age	-8.76	2.00	0.00
ITSEX	Learner sex	-27.50	2.80	0.00
TIMEL	Learner time spent reading	-9.55	1.42	0.00
OPPUSEL	Reading opportunity used by learner	10.50	1.33	0.00
TIMEPAR	Reading time created by parent	2.00	1.24	0.11
OPPAR	Reading opportunity created by parent	-8.32	1.27	0.00
SOCLP	Learner and parent social background	6.30	1.51	0.00

Table 8.4 (above) indicates that, after taking all explanatory variables into account, Afrikaans learner achievement is 10.9 points (SE=11.2) lower than English, which serves as the control language for this model. This decrease is, however, not statistically significant, therefore there is no statistical difference between Afrikaans and English learners' reading achievement. However, all the African language grouping average reading achievement scores are lower than the reference – a significant decrease of 70.9 points (SE=12.8) for the Nguni group, a significant 68.0 point (SE=11.8) decrease for the Sotho grouping, as well as a significant 73.5 point (SE=15.8) decrease for Tshivenda. These results indicate that, relative to English, the Afrikaans language grouping is the only

one of the five tested South African language groupings whose average reading achievement score does not differ significantly from English, the control language for which the intercept was 524.3 (SE=22.5). On the other hand, children writing the test in the African language groupings tend to achieve considerably lower scores than those in Afrikaans and English.

Table 8.4 (above) also indicates that none of the classroom-level variables are significant[16] in the overall model. The only significant factor at school-level is the *reading opportunity created by the teacher*. Where teachers fail to create such opportunities for learners, average reading achievement appears to be 14.1 (SE=5.4) points lower.

A variable for school socio-economic status was included in the analyses. This variable was created to convey the social background of the school by averaging indices of resources across Grade 5 learners. The interpretation of the model now allows for explanations of teacher and school-level time spent on *reading, opportunities created by the teacher and school for reading* and *the quality of teachers* that may vary across the districts within those socio-economic contexts that are accounted for in the model. The overall model therefore shows that, after taking teacher and school time spent on reading, opportunities created for reading and teacher quality into account, school socio-economic status nonetheless show 69.1 (SE=5.2) points higher average reading achievement. The large and educationally important effect of school socio-economic status of learners in this South African model is therefore consistent with other research, including that of Bos, Schwippert and Stubbe (2007), who refer to 'social capital' when identifying socio-economic status as the major predictor of differential reading achievement.

Explanatory factors at the learner-level are all statistically significant contributors to average reading achievement scores, except for reading time created by parents. The overall results show that for each additional year of learner age in Grade 5, reading achievement is lower by 8.76 (SE=2.0) points.

[16] Significance for all models is reported where p=<0.01.

Sex differences in reading achievement favour girls by 27.5 (SE=2.8) points[17]. Where learners do not spend time on reading, reading achievement scores are lower by 9.6 (SE=1.4) points. Where learners use opportunities to read, reading achievement is 10.5 (SE=1.3) points higher. The different effects of these two factors on reading achievement may point to possible interaction effects, since there may only be a conceptual distinction between time spent on reading and opportunities used to read. Nevertheless, learner-level factors indicate a pattern where older learners (boys in particular), who spend less time on reading, who do not use opportunities to read and who are likely to come from lower socio-economic backgrounds, tend to achieve lower scores in reading.

Where parents fail to create opportunities for their children to read, average reading achievement is lower by 8.3 (SE=1.2) points. Significantly, Table 8.4 (above) shows that parents' reported time spent on reading with their children does not greatly influence average reading achievement scores. Whilst the reason for this result is not clear, it does not necessarily imply that time has no influence. It is also possible that parents may over-report the time that spent on reading with their children.

Lastly, the overall South African model indicates that parent and learner social background, as measured by possessions in the home and parents' level of educational qualifications is significantly associated with average reading achievement scores. In higher socio-economic households, average reading scores are higher by 6.3 (SE=1.5) points compared to those households with lower socio-economic status, fewer possessions and lower educational qualifications for parents. These factors are all interrelated and confirm research conducted internationally.

Table 8.5 indicates the variance components for the overall model:

[17] All variables were coded from low to high. In the case of sex, girls are identified by 1, boys by 2, therefore the decrease in reading achievement scores would pertain to boys' achievement. In the case of time spent on reading, low frequencies (never or almost never) were coded as 1, high frequencies (once or twice a week or every day) were coded as 2.

Table 8.5: Variance Components for the Overall Model

Variance between schools	7 671.91
Variance within schools	6 822.94

The variance component of the overall model when language groupings are not included in the model indicates that the variance between schools (7 671.91) is larger than the variance within schools (6 822.94). This means that 11% of variance in reading literacy achievement is accounted for at school-level. This pattern is typical of that found in developing countries (Howie, 2002; Passos, 2009) and contrary to the pattern of variance in developed countries where variance within schools is larger than that between schools. An implication of a larger variance between schools means that interventions may more easily be implemented, since the intervention can be tailored at school-level to meet the needs of the school. With a larger variance within schools, planning and implementing interventions become more complicated, since differences at classroom-level are much more varied and particular interventions that are not specially designed for individual circumstances often do not address the variations encountered within the class.

However, with the inclusion of language groupings in the model, the variance component changes significantly to a pattern where variance within schools is larger than between (6 687.03 within schools as opposed to 2 512.04 between schools). This difference in variance components for the overall model suggests that the inclusion of language groupings in the model accounts for 36% of variance in the overall South African model. Figure 8.1 (below) illustrates the changes in variance given the three scenarios, namely the estimated variance for the null model (42%), the substantial decrease in variance for the overall model without controlling for language groupings (11%), and the increased variance for the overall model with the addition of language groupings (36%):

The remainder of this chapter will provide results of models for each of the language groupings separately in order to ascertain the particular explanatory factors for each of the language groupings at learner-, classroom- and school-level.

8.2. RESULTS FOR THE AFRIKAANS MODEL

A total number of 1 678 Grade 5 learners completed the PIRLS 2006 assessment in Afrikaans. This number of learners represents not only those who speak Afrikaans at home, but also those who speak another language at home but who have been receiving instruction in Afrikaans from Grade 1 to Grade 3 at an Afrikaans-medium school. Grade 5 learners who wrote the PIRLS 2006 assessment in Afrikaans achieved the highest average score of all the language groupings (415.7, SE=12.0).

The null model for the Afrikaans language grouping resulted in the following estimated variance components:

Table 8.6: Estimation of the Variance Components in the Afrikaans Null Model

Variables	Estimate	SE
Grand mean	414.9	18.7
Variance components:		
School-level	17 552.7	
Learner-level	7 449.3	

As indicated by Table 8.6 (above), the Afrikaans school-level variance is substantially larger than the learner-level variance, resulting in the between school variance for Afrikaans learner reading achievement in the null model as 57% of the total variance.

Two Afrikaans models were generated, the first including only learner-level factors, the second learner- and school-level factors. Table 8.7 (below) provides results for the Afrikaans model where learner-level factors of *age, sex*, *learner time spent on reading* and *reading opportunity used by learners* were included. Parental factors included in the final selected model were *time spent by parents to read with the child, opportunities created by parents for reading* and *social background* as measured by possessions in the home and parental qualifications. The Afrikaans learner-level model output is reported in Table 8.7:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + u_0$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$
$$\beta_8 = \gamma_{80}$$

Table 8.7: Afrikaans Learner-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	405.21	15.08	0.00
Learner-Level				
ITAGE	Learner age	-16.28	3.13	0.00
ITSEX	Learner sex	-25.50	5.00	0.00
TIMEL	Learner time spent reading	-5.40	2.74	0.06
OPPUSEL	Reading opportunity used by learner	2.33	2.90	0.41
TIMEPAR	Reading time created by parent	3.25	2.22	0.14
OPPAR	Reading opportunity created by parent	-9.75	2.70	0.00
SOCLP	Learner and parent social background	12.00	2.28	0.00

For this model, a sizeable drop of 16.3 (SE=3.1) points is suggested for each additional year of age of a child in Grade 5 that the child remains in Grade 5. The model also fits a 25.5 (SE=5.0) points lower average achievement score for Afrikaans boys compared to girls. The time spent on reading by these learners and opportunities used to read, do not significantly affect average reading scores. Parents who create time to read with their children are not a significant factor in this model, yet parents who do not create the opportunities to read are associated with a significant 9.8 (SE=2.7) points lower average reading score.

For the Afrikaans learner-level model, there is an interaction effect between parental time spent on reading and opportunities created to read. As was the situation in the overall model, a decrease in one factor with an increase in the other indicates possible interaction. Of interest in the Afrikaans model is the social background of learners, with a 12.0 (SE=2.3) points higher average reading score for those learners in possession of basic (and some luxury) belongings at home and parents with educational qualifications.

Table 8.8 indicates the variance component for this part of the model:

Table 8.8: Variance Components for the Afrikaans Model:

Variance between learners	11 801.60
Variance within learners	6 663.81

Table 8.8 (above) indicates that variance between Afrikaans learners is larger than variance within learners, therefore 43% of variance in reading achievement for Afrikaans learners is explained at learner-level. The data suggest the school-level variables should be explored as possible explanatory factors for school variability. School-level factors are therefore included in the model:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(MSOCLP) + \gamma_{02}(QUALT) + \gamma_{03}(TIMET) + \gamma_{04}(OPPUSET) + \gamma_{05}(QUALEDS) + \gamma_{06}(TIMES) + \gamma_{07}(OPPORS) + \gamma_{08}(MISSTORS) + u_0$$

$$\beta_1 = \gamma_{10}$$

$$\beta_2 = \gamma_{20}$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

Table 8.9: Afrikaans Learner- and School-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	379.10	6.75	0.00
School and Classroom-Level				
MSOCLP	School socio-economic status	87.60	6.26	0.00
QUALT	Teacher quality	6.60	8.34	0.43
TIMET	Teacher time spent on reading in class	2.88	13.80	0.83
OPPUSET	Reading opportunity created by teacher	5.36	9.06	0.55
QUALEDS	School educational quality	14.34	6.26	0.02
TIMES	School time spent reading	8.34	6.55	0.56
OPPORS	Reading opportunity created by school	1.31	7.50	0.86
Learner-Level				
ITAGE	Learner age	-16.49	3.13	0.00
ITSEX	Learner sex	-25.48	4.94	0.00
TIMEL	Learner time spent reading	-5.13	2.70	0.06
OPPUSEL	Reading opportunity used by learner	3.13	2.90	0.27
TIMEPAR	Reading time created by parent	2.70	2.23	0.23
OPPAR	Reading opportunity created by parent	-10.05	2.70	0.00
SOCLP	Learner and parent social background	10.02	2.32	0.00

Results for the Afrikaans model shows that none of the selected school-level factors included in the model have a significant effect on average reading achievement scores apart from the school socio-economic variable. This predictor is associated with a significant 87.6 (SE=6.3) points higher average reading achievement score for learners who receive instruction in Afrikaans. The impact of the socio-economic variable may also be explained by the large contingent of Coloured learners who attend Afrikaans schools, specifically in the Western and Northern Cape. These learners are generally from lower socio-economic households, in stark contrast to their White counterparts who are generally from more affluent backgrounds. Within the Afrikaans learner population, sharp contrasts therefore exist in terms of socio-economic background.

Statistically significant variables of the learner-level model appear again in the fitted multi-level model. Average reading achievement is lower by 16.5 (SE=3.1) for each additional year of age amongst Afrikaans Grade 5 learners. Sex is associated with a 25.5 (SE=4.9) higher average for Afrikaans girls compared to Afrikaans boys. The claimed opportunities created by parents to engage their children in reading is associated with 10.1 (SE=2.7) points lower reading achievement. The social background of learners is associated with 10.0 points (SE=2.3) higher average for those children from higher socio-economic background.

The variance components of the Afrikaans model confirm that school variability is strongly tied to socio-economic status and perhaps school educational quality:

Table 8.10: Afrikaans Model Variance Components without and with School-Level Variables

	Afrikaans Learner-Level Model Only	**Afrikaans Learner and School-Level Model**
Variance between schools	11 801.58	2 590.25
Variance within schools	6 663.81	6 659.66

The changes in variance indicated by Table 8.10 (above) means that 47%[18] of variance is accounted for by the addition of school-level variables to the Afrikaans model.

8.3. RESULTS FOR THE ENGLISH MODEL

For PIRLS 2006, the group of Grade 5 learners completing the assessment in English possibly constitutes the most heterogeneous group of learners. Some speak English at home, but there are many learners from African language backgrounds whose parents prefer them to attend schools where they receive instruction in English. The group therefore comprises not only English first language speakers, but also English second- or even third-language speakers who receive instruction in English. This phenomenon is particularly apparent for inner-city and urban schools, where many parents from townships choose to send their children to English medium schools instead of township schools.

The null model for the English grouping generated the following estimates:

Table 8.11: Estimation of the Variance Components in the English Null Model

Variables	Estimate	SE
Grand mean	418.33	18.1
Variance components:		
School-level	10 486.9	
Learner-level	7 405.6	

This output confirms the presence of substantial variability associated with schools.

The PIRLS 2006 average result for the English group of Grade 5 learners was 398.0 (SE=17.1), with 2 793 learners having completed the assessment in

[18] Variance for the learner model was obtained as follows: 11 801.58+6 663.81=18 465.39. Variance for the learner and school model was obtained as 2 590.25+6 659.66=9 249.91, resulting in the subtraction of learner and school model variance from learner model variance (17 465.39-9 249.91=8 215.48). The final result of 8 215.48/17 465.39 resulted in 0.47, or 47% variance. This procedure was followed in computing variance for all models discussed in this chapter.

English. Two English models were generated, the first including only learner-level factors, the second including learner- and school-level factors. The English learner-level model notation is followed by Table 8.12, which reports learner-level results:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + u_0$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$
$$\beta_8 = \gamma_{80}$$

Table 8.12: English Learner-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	412.91	13.93	0.00
Learner-Level				
ITAGE	Learner age	-31.70	6.44	0.00
ITSEX	Learner sex	-23.70	5.60	0.00
TIMEL	Learner time spent reading	-9.00	3.66	0.02
OPPUSEL	Reading opportunity used by learner	3.17	4.81	0.51
TIMEPAR	Reading time created by parent	1.75	3.11	0.57
OPPAR	Reading opportunity created by parent	-11.20	3.31	0.00
SOCLP	Learner and parent social background	14.00	3.09	0.00

The English learner-level model indicates associations between assessment scores and the factors learner *age, sex, opportunities created by parents to engage their children in reading* and *social background*. Older age groups in Grade 5 have reading scores some 31.7 points (SE=6.4) lower for each

additional increase of one year in age. Boys achieve on average 23.7 points (SE=5.6) lower than girls. Opportunities created by parents are linked to 11.2 point (SE=3.3) lower reading achievement. It is possible that parents of lower achievement learners are over-reporting opportunities they create.

Table 8.13 (preceded by the model notation) provides results for the English level model when classroom- and school-level variables are added to the learner-level variables:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(MSOCLP) + \gamma_{02}(QUALT) + \gamma_{03}(TIMET) + \gamma_{04}(OPPUSET) + \gamma_{05}(QUALEDS) + \gamma_{06}(TIMES) + \gamma_{07}(OPPORS) + \gamma_{08}(MISSTORS) + u_0$$

$$\beta_1 = \gamma_{10}$$

$$\beta_2 = \gamma_{20}$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

Table 8.13: English Learner- and School-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	405.33	6.26	0.00
School and Classroom-Level				
MSOCLP	School socio-economic status	71.05	7.46	0.00
QUALT	Teacher quality	14.58	9.70	0.13
TIMET	Teacher time spent on reading in class	24.63	13.36	0.07
OPPUSET	Reading opportunity created by teacher	-23.00	8.50	0.10
QUALEDS	School educational quality	3.70	4.30	0.40
TIMES	School time spent reading	3.70	8.03	0.64
OPPORS	Reading opportunity created by school	-0.52	7.56	0.94
Learner-Level				
ITAGE	Learner age	-31.70	6.44	0.00
ITSEX	Learner sex	-23.53	5.62	0.00
TIMEL	Learner time spent reading	-8.06	3.61	0.02

OPPUSEL	Reading opportunity used by learner	4.00	4.84	0.41
TIMEPAR	Reading time created by parent	1.00	3.12	0.75
OPPAR	Reading opportunity created by parent	-11.44	3.28	0.00
SOCLP	Learner and parent social background	11.82	3.23	0.00

Table 8.13 (above) indicates that although teacher- and school-level factors of *quality, time* and *opportunity used to engage learners in reading activities* are not directly significant in the English model, they nevertheless contribute within the social context of a school's socio-economic status. Higher socio-economic status links with higher average reading achievement by 71.1 points (SE=7.5).

At learner-level, *age, sex, opportunities created by parents to engage their children in reading activities* and *social background* remain factors linked to higher or lower reading achievement for the English group of learners. As with the socio-economic status at school-level, a higher social background at learner-level significantly increases reading achievement by 11.8 points (SE=3.2) for English learners.

Table 8.14 reports variance components for the English learner-level only model, and the model with school-level variables:

Table 8.14: English Model Variance Components without and with School-Level Variables

	English Learner-Level Model Only	**English Learner- and School-Level Model**
Variance between schools	6 341.16	1 344.11
Variance within schools	6 339.85	6 335.47

The changes in variance indicated by Table 8.14 (above) mean that 39% of variance is accounted for with the addition of school-level variables to the English model.

8.4. RESULTS FOR THE NGUNI MODEL

The Nguni language grouping consists of Grade 5 learners who wrote the PIRLS 2006 assessment in isiZulu, isiXhosa, isiNdebele, SiSwati and Xitsonga. As a language grouping, learners' average achievement for PIRLS 2006 was 243.3 (SE=4.4), an average score substantially lower than the international average of 500 and lower than average achievement scores obtained by the Afrikaans (351.7, SE=12.0) and English (346.8, SE=17.5) groups of Grade 5 learners. The Nguni language grouping consisted of 6 039 learners, and hence is the largest group of learners amongst the five language groupings.

The null model for the Nguni language grouping resulted in the following estimated variance components:

Table 8.15: Estimation of the Variance Components in the Nguni Null Model

Variables	Estimate	SE
Grand mean	243.3	5.5
Variance components:		
School-level	2 144.4	
Learner-level	7 266.9	

In each of the previous null models presented for the overall, Afrikaans and English groups, school-level variance was substantially larger than the learner-level variance. For the Nguni null model, a reversed situation occurs, where variance at learner-level is much larger than variance found at school-level. The Dutch experience[19] indicates that variation is predominantly found between schools, therefore any interventions can effectively be targeted and implemented at school-level. In South Africa (and more particularly in light of the Nguni model results of this study) the implication of this learner-level variance being larger than the school variance for Black learners serves not only to indicate South Africa's problem in terms of its learner diversity, but also points to problems where any intervention for Nguni learners is likely to be considerably more difficult. In essence, effective intervention cannot be

[19] As discussed with Professor Roel Bosker, Rijksuniversiteit Groningen, The Netherlands

successfully implemented or aimed at the school-level, but must address the presence of substantial variation between learners in the same classrooms.

Two Nguni models were generated, the first including only learner-level factors, the second including learner- and school-level factors. The Nguni learner-level model, followed by Table 8.16, explore for Nguni learners with associations of *age*, *sex, learner and parent time spent on reading, learner opportunities used* and *parental opportunities created to read* as well as *social background*:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + u_0$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$
$$\beta_8 = \gamma_{80}$$

Table 8.16: Nguni Learner-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	360.06	28.90	0.00
Learner-Level				
ITAGE	Learner age	-3.96	2.43	0.11
ITSEX	Learner sex	-31.00	4.37	0.00
TIMEL	Learner time spent reading	-11.31	2.24	0.00
OPPUSEL	Reading opportunity used by learner	14.38	2.05	0.00
TIMEPAR	Reading time created by parent	1.81	1.87	0.33
OPPAR	Reading opportunity created by parent	-4.40	2.61	0.10
SOCLP	Learner and parent social background	-27.14	4.28	0.00

The Nguni learner-level model output reports that learner *sex* is linked to reading achievement. Nguni boys achieve on average 31.0 points (SE=4.4) lower than girls. Interestingly, *age* is not a significant factor for the Nguni group, unlike for the Afrikaans and English groups of learners. *Learner time spent on reading* and *reading opportunities used by learners* are linked to contrasting effects. Learners who spend some time reading have a lower level of reading achievement (-11.3, SE=2.2) and learners using opportunities to read have higher reading achievement (14.38, SE=2.1).

As in the Afrikaans and English models at learner-level, learner *social background* significantly associates with reading achievement. For Nguni learners, average reading achievement scores are as many as 27.1 points (SE=4.3) lower for learners from impoverished backgrounds as characterized by a lack of basic possessions or educationally qualified parents.

The Nguni learner-level model indicates that the variance component for the Nguni grouping consists of a larger variance within schools (6 701.18) than between schools (2 054.24). This learner-level pattern confirms previous discussions of explained variance for the null model, where variance at learner-level in the null model is also more pronounced than at school-level.

Preceded by the model notation, Table 8.17 provides results for the Nguni learner- and school-level model once classroom- and school-level variables are added to the model:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(MSOCLP) + \gamma_{02}(QUALT) + \gamma_{03}(TIMET) + \gamma_{04}(OPPUSET) + \gamma_{05}(QUALEDS) + \gamma_{06}(TIMES) + \gamma_{07}(OPPORS) + \gamma_{08}(MISSTORS) + u_0$$

$$\beta_1 = \gamma_{10}$$

$$\beta_2 = \gamma_{20}$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

Table 8.17: Nguni Learner- and School-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	364.29	32.58	0.00
School and Classroom-Level				
MSOCLP	School socio-economic status	13.35	12.14	0.27
QUALT	Teacher quality	12.21	9.89	0.21
TIMET	Teacher time spent on reading in class	-0.53	5.88	0.92
OPPUSET	Reading opportunity created by teacher	-15.00	8.06	0.06
QUALEDS	School educational quality	-0.32	5.17	0.95
TIMES	School time spent reading	8.46	5.60	0.13
OPPORS	Reading opportunity created by school	-0.01	4.60	0.99
Learner-Level				
ITAGE	Learner age	-3.91	2.43	0.12
ITSEX	Learner sex	-30.98	4.36	0.00
TIMEL	Learner time spent reading	-11.40	2.23	0.00
OPPUSEL	Reading opportunity used by learner	14.50	2.05	0.00
TIMEPAR	Reading time created by parent	1.84	1.87	0.32
OPPAR	Reading opportunity created by parent	-4.42	2.62	0.09
SOCLP	Learner and parent social background	1.95	2.80	0.50

In adding classroom- and school-level variables to the Nguni model, none of these factors were found to have discernible associations. Significant factors that influence reading achievement for this group of learners remain at the learner-level, with learner *sex, time spent reading* and *opportunities used to read* being factors of significance. When school-level variables are added to the model, the associations are largely unchanged. Boys still achieve 31.0 points (SE=4.4) lower in average achievement than girls. Nguni learners who do not spend *time reading* achieve on average 11.4 points (SE=2.2) lower, and *opportunities used by learners to read* increases reading achievement scores to 14.5 points (SE=2.1).

For the learner-level model alone, learner *social background* was of significance in influencing average reading achievement scores. As indicated by Table 8.17 (above), learners from impoverished backgrounds are likely to have lower reading achievement scores by as many as 27 points. Yet, with the addition of the school-level variables to the Nguni model, the influence of the learner's social background is diminished and of non-significance at 0.50.

Of interest is also the indiscernible effect of the school's socio-economic status on reading achievement (p=0.27) in the Nguni model. This artifact could be explained by the reasoning that there may be no Nguni schools of higher socio-economic status, therefore the effect of resources and socio-economic status on learner achievement cannot be detected in the current data. While the availability of resources and higher socio-economic status is associated with the Afrikaans and English sector, this factor may not yet be as pronounced for learners from the Nguni grouping. Socio-economic factor results for the Nguni language grouping models are surprising in light of expectations that the factor would be significant. It might be the situation for this data because of large variance and the nature of the effect of socio-economic status being conflated by other factors.

Despite the statistical nonsignificance of socio-economic status for the Nguni model, at this point a useful distinction should be made between statistical significance and educational significance. Whilst the former designates

indicators that flag numerically significant relationships in data, the latter points to those factors that are of importance within the educational landscape based on interpretation from a specialist and practitioner point of view. Thus, whilst data may fail to show statistical significance, measured factors or relationships between variables may still be of educational significance.

That the addition of school-level variables to the Nguni model apparently contributes no significant factors to the model can be supported with evidence from the percentage of variance explained. Table 8.18 shows the differences in variance for the Nguni learner-level model only and the learner- and school-level models:

Table 8.18: Nguni Model Variance Components without and with School-Level Variables

	Nguni Learner-Level Model Only	**Nguni Learner- and School-Level Model**
Variance between schools	2 054.24	1 977.38
Variance within schools	6 701.18	6 700.95

The addition of the school-level variables that have been added to the Nguni level model explains less than 1% of variance found for this grouping of learners.

8.5. RESULTS FOR THE SOTHO MODEL

The Sotho language grouping comprises Grade 5 learners who completed the PIRLS 2006 assessment in Sesotho, Setswana and Sepedi. A total number of 3 363 Grade 5 learners constitute the Sotho language grouping with an average PIRLS 2006 achievement of 267.1 (SE=5.2%). Amongst the African language groups in the sample, the Sesotho and Setswana learners achieved the highest average scores in the PIRLS 2006 assessment of 288.6 (SE=7.6) and 288.1 (SE=12.1) respectively.

The null model for the Sotho language grouping resulted in the following estimated variance components:

Table 8.19: Estimation of the Variance Components in the Sotho Null Model

Variables	Estimate	SE
Grand mean	270.3	5.9
Variance components:		
School-level	2 115.8	
Learner-level	7 069.6	

For the Sotho null model, variance estimates at learner-level are much larger than variance found at school-level. The implication of this learner-level variance than school-level variance is the same in the Nguni model, that is South Africa has a noteworthy problem in terms of its learner diversity dominating school variability, specifically for African language learners, thereby making effective intervention with these already struggling learners considerably more difficult in schools with very diverse learner scores. For the purposes of this study, the Sotho language group was made up of learners from Sepedi, Sesotho and Setswana backgrounds. While these groups share linguistic similarities, the null model estimates confirm that great variance exists within learners despite their linguistic similarities.

Two Sotho models were generated, the first including only learner-level factors, the second model including learner- and school-level factors. Table 8.20 provides results for the Sotho learner-level model, preceded by the model's notation:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + u_0$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$
$$\beta_8 = \gamma_{80}$$

Table 8.20: Sotho Learner-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	479.52	32.74	0.00
Learner-Level				
ITAGE	Learner age	-11.61	2.48	0.00
ITSEX	Learner sex	-24.60	4.04	0.00
TIMEL	Learner time spent reading	-8.00	3.00	0.01
OPPUSEL	Reading opportunity used by learner	13.00	2.15	0.00
TIMEPAR	Reading time created by parent	1.47	2.40	0.54
OPPAR	Reading opportunity created by parent	-8.06	2.32	0.00
SOCLP	Learner and parent social background	3.04	2.75	0.27

Table 8.20 (above) indicates statistically significant results for the Sotho learner-level model for all the variables that pertain to the learner directly. In this model, learner *age* is linked to lower average reading achievement by 11.6 points (SE=2.5) for each additional year increase of Grade 5 learner age. Consistent with patterns in other language groupings, boys in the Sotho model have significantly lower reading achievement scores than girls, by as much as 24.6 points (SE=4.0). The less *time learners spend on reading and reading related activities*, the lower the average reading achievement score is likely to be, by as many as 8 points (SE=3.0). *Reading opportunities used by learners* have a

positive effect on reading achievement scores, with 13 points (SE=2.2) higher averages where learners make use of opportunities to read.

As in the Nguni model, there is an interaction observed between these two factors, where the increase in scores for time spent on reading cannot be separated from the decrease in scores for learner opportunities used to read.

Parental variables of significance in the Sotho model pertain mainly to *parents' creation of opportunities for children to read.* Where parents fail to create these reading opportunities for the child, reading achievement scores are substantially lower by 8.06 points (SE=2.3).

The Sotho learner-level model shows that the *social background* factors associated at the learner-level are not associated with reading achievement scores. A similar explanation as that offered for the Nguni model could apply here too, where the effect of social background in the Sotho model cannot be suitably differentiated due to the absence in most cases of proxy measures such as possessions at home or parental qualifications.

The Sotho learner- and school-level model notation and Table 8.21 report the Sotho level model with the addition of classroom- and school-level variables:

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$ASRREA01 = \beta_0 + \beta_1(ITAGE) + \beta_2(ITSEX) + \beta_3(TIMEL) + \beta_4(OPPUSEL) + \beta_5(TIMEPAR) + \beta_6(OPPPAR) + \beta_7(SOCLP) + \beta_8(MISSLORP) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(MSOCLP) + \gamma_{02}(QUALT) + \gamma_{03}(TIMET) + \gamma_{04}(OPPUSET) + \gamma_{05}(QUALEDS) + \gamma_{06}(TIMES) + \gamma_{07}(OPPORS) + \gamma_{08}(MISSTORS) + u_0$$

$$\beta_1 = \gamma_{10}$$

$$\beta_2 = \gamma_{20}$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

Table 8.21: Sotho Learner and School-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	487.02	35.81	0.00
School and Classroom-Level				
MSOCLP	School socio economic status	8.82	25.57	0.73
QUALT	Teacher quality	10.16	7.69	0.19
TIMET	Teacher time spent on reading in class	-1.77	7.53	0.81
OPPUSET	Reading opportunity created by teacher	-16.21	7.50	0.03
QUALEDS	School educational quality	8.06	5.41	0.14
TIMES	School time spent reading	10.15	5.40	0.06
OPPORS	Reading opportunity created by school	-4.46	5.13	0.39
Learner-Level				
ITAGE	Learner age	-11.37	2.50	0.00
ITSEX	Learner sex	-24.52	4.05	0.00
TIMEL	Learner time spent reading	-8.15	3.00	0.01
OPPUSEL	Reading opportunity used by learner	12.95	2.14	0.00
TIMEPAR	Reading time created by parent	1.43	2.40	0.55
OPPAR	Reading opportunity created by parent	-8.08	2.30	0.00
SOCLP	Learner and parent social background	2.93	2.72	0.28

After the addition of school-level variables to the Sotho model, only some variables found at learner-level were of statistical significance. Greater age for Sotho learners at Grade 5 level is associated with average reading achievement scores down by 11.4 points (SE=2.5) per year, and boys have lower average reading achievement scores compared to girls, by as many as 24.5 points (SE=4.1). As with the lone-standing Sotho learner-level model, *time learners spend on reading* and *opportunities used to read* significantly affects reading achievement scores – less time spent on reading links to 8.2 points (SE=3.0) lower average reading achievement scores. *Opportunities used to read* have higher reading scores by 13.0 points (SE=2.1).

Table 8.22 reports the differences in variance for the Sotho learner-level model only and the learner and school-level model:

Table 8.22: Sotho Model Variance Components without and with School-Level Variables

	Sotho Learner-Level Model Only	Sotho Learner- and School-Level Model
Variance between schools	1 880.12	1 651.85
Variance within schools	6 535.98	6 535.27

Table 8.22 confirms that the addition of the school-level variables within the Sotho learner-level model explains very little of the variation.

8.6. RESULTS FOR THE TSHIVENDA MODEL

The Tshivenda grouping constitutes the smallest group of learners, with only 784 who completed the PIRLS 2006 assessment in Tshivenda. With PIRLS 2006 achievement scores of 262.1 (SE=15.0), the Tshivenda grouping's average reading achievement is comparable to that of the Nguni and Sotho groupings and substantially below that of the Afrikaans and English group of learners.

Due to the small sample size (only 20 Tshivenda schools in the national PIRLS 2006 sample), only a learner-level model will be presented for purposes of

analyzing the Tshivenda data. The null model for the Sotho language grouping resulted in the following estimated variance components:

Table 8.23: Estimation of the Variance Components in the Sotho Null Model

Variables	Estimate	SE
Grand mean	265.8	13.1
Variance components:		
School-level	1 231.8	
Learner-level	7 665.3	

The Tshivenda null model replicates results and implications that were found for the Nguni and Sotho null models, namely that variance estimates at learner-level are much larger than variance found at school-level.

Table 8.24 provides results of the Tshivenda learner-level model on aspects of learner *age, sex, learner and parent time spent on reading, learner opportunities used to read, parent opportunities created to read* and *social background*.

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$\text{ASRREA01} = \beta_0 + \beta_1(\boldsymbol{ITAGE}) + \beta_2(\boldsymbol{ITSEX}) + \beta_3(\boldsymbol{TIMEL}) + \beta_4(\boldsymbol{OPPUSEL}) + \beta_5(\boldsymbol{TIMEPAR}) + \beta_6(\boldsymbol{OPPPAR}) + \beta_7(\boldsymbol{SOCLF}) + \beta_8(\boldsymbol{MISSLORF}) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00}$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$
$$\beta_8 = \gamma_{80}$$

Table 8.24: Tshivenda Learner-Level Model Results

Factor Name	Fixed Effect	Coefficient	Standard Error	P-Value
	Intercept	259.37	11.04	0.00
Learner-Level				
ITAGE	Learner age	-26.21	7.92	0.00
ITSEX	Learner sex	-17.50	10.50	0.10
TIMEL	Learner time spent reading	-11.01	6.26	0.08
OPPUSEL	Reading opportunity used by learner	16.32	4.48	0.00
TIMEPAR	Reading time created by parent	1.20	4.90	0.80
OPPAR	Reading opportunity created by parent	-8.22	6.50	0.20
SOCLP	Learner and parent social background	6.30	7.02	0.38

Of statistical significance for the Tshivenda model is learner *age* and *opportunities used by learners to read.* Average reading achievement scores are 26.2 points (SE=7.9) lower for each additional one year increase of age for a Tshivenda learner at Grade 5 level. In terms of opportunities used by learners to read, reading achievement scores are substantially higher by 16.3 points (SE=4.5) when these opportunities are reported by learners.

Variance components for the Tshivenda learner-level model reveal that the variance within schools (6 915.50) is larger than that between schools (928.99). Due to the small sample size of this group, these results should be interpreted with caution, especially in light of the addition of the school socio-economic indicator to the model still explaining less than 1% of the variance (i.e. insufficient variation in schools).

8.7. SUMMARY OF RESULTS

Chapter 8 provided results for the HLM models, first for the null (or empty) models, then with variables that were created with standardized scores and included at both learner- and school-level. Results of an overall model were provided, followed by the results for each language grouping separately, first

providing results for the learner-level only, then for both learner- and school-levels.

Apart from model results for each language grouping, explained variance was presented for each language grouping in terms of the null model, the learner-level and learner- and school-level models. Variance patterns for the overall model suggests that as much as 36% of variance can be explained with the addition of language to the model.

Variance patterns for the Afrikaans and English models confirmed that the percentage of explained variance for these groups was consistently greater at school-level. This implies that the effect of school-level variables is more pronounced for these learners and may explain more of the variance in reading achievement.

A reversed pattern of variance was found for the Nguni, Sotho and Tshivenda groupings, with much more pronounced variance found at learner-level. Such a pattern confirms that much more variance in reading achievement is explained at learner-level for these groups of learners, thereby emphasizing the great diversity of the African language learners' profiles and the complexity with which any interventions or strategies should be implemented to take this variation at learner-level effectively into account.

Furthermore, there is less than 1% of explained variance at school-level for the African languages (i.e. Nguni, Sotho and Tshivenda) in this study. This lack of explained variance suggests that perhaps more explanation can be expected when languages are to be treated separately.

The conclusion that can be drawn from the results of Figure 8.7 is that exploratory methods may be more appropriate when working with African languages, since in this study the confirmatory approach only worked for Afrikaans and English learners, who all attend schools that follow a mainly western tradition. It may well have occurred that, due to the use of confirmatory methods, important variables that could have explained more for the African

languages, have inevitably been excluded from the models. Relevant sources of variation may therefore not be represented in the model and might have been overlooked.

Table 8.25 highlights statistically significant coefficients for each of the models:

Table 8.25: Summary of Model Results in the Presence of Other Coefficients

Fixed Effect	Overall	Afrikaans	English	Nguni	Sotho	Tshivenda
School and Classroom-Level						
School socio-economic status	69.10	87.60	71.05	-	-	-
Afrikaans	-10.93	-	-	-	-	-
Nguni	-70.90	-	-	-	-	-
Sotho	-68.00	-	-	-	-	-
Tshivenda	-73.51	-	-	-	-	-
Teacher quality	-	-	-	-	-	-
Teacher time spent on reading in class	-	-	-	-	-	-
Reading opportunity created by teacher	-14.12	-	-	-	-	-
School educational quality	-	-	-	-	-	-
School time spent reading	-		-	-	-	-
Reading opportunity created by school	-		-	-	-	-
Learner-Level						
Learner age	-8.76	-16.49	-31.70	-	-11.37	-21.81
Learner sex	-27.50	-25.48	-23.53	-30.98	-24.52	-
Learner time spent reading	-9.55	-	-	-11.40	-8.15	-
Reading opportunity used by learner	10.50	-	-	14.50	12.95	14.55
Reading time created by parent	-	-	-	-	-	-
Reading opportunity created by parent	-8.32	-10.05	-11.44	-	-8.08	-
Learner and parent social background	6.30	10.02	11.82	-	-	-

The statistical significance of the school socio-economic variable for the overall model, the Afrikaans and English models is noted. The apparent absence of socio-economic effects for the African languages may be explained by an absence of variance between schools for the African language groupings, for whom very few well-resourced schools were available in the South African PIRLS 2006 sample.

The overall model utilized the English average reading achievement scores as the arbitrary reference intercept against which the achievement of all other language groupings could be compared. Although a decrease in reading score is shown for Afrikaans when compared to English as the control language, this decrease appears minor. Of clear significance, however, was the decrease in average reading achievement for each of the African language groupings when English was used as control. These results provide statistical evidence that African language achievement is lower when compared to the Afrikaans and English groups of Grade 5 learners.

For the overall model, reading opportunities created by the teacher are highlighted as the only factor that affects reading achievement significantly. In the separate language grouping models, all the significant factors are found at learner-level. Learner age and sex appear consistently as determining factors for reading achievement, with the exception of the Nguni group where age was not significant and for the Tshivenda group where sex was not a significant factor in achievement.

Learner time spent reading and opportunities used to read were found to be of significance in the overall model and the Nguni, Sotho and Tshivenda models. From these results one could deduce that among learners from African language groupings contrasting achievements, reading habits, behaviour and motivation are linked to the learners themselves rather than school factors.

A different pattern is observed for the results of the overall model, Afrikaans, English and Sotho models. Results from these models suggest that learner reading achievement is substantially more influenced by the role of the parents. For these models, learners whose parents create opportunities for children to read have higher scores for reading achievement. This pattern is in contrast to the African language models where learners' reading achievement seems influenced by their own time spent and opportunities used for reading. The results for the overall, Afrikaans, English and Sotho models would suggest that these learners' reading achievement are partly influenced and mediated by the role of the parents.

In Chapter 1, the diminished role of parents, specifically in Black communities, was mentioned. The role of HIV-Aids and its consequences on the increased occurrence of child-headed households in South Africa was described as a factor with which the South African educational system will likely have to contend in future. This social background may explain the nonsignificance of parental opportunities created and time spent on reading in the Nguni and Tshivenda models. Yet the opposite may be true for the Sotho model, where results of the model provide evidence for the significant importance of parental involvement in reading for these children. Parental involvement may also explain why Sotho learners achieved on average the highest in the PIRLS 2006 assessment of all the African languages. Despite these plausible interpretations, the results of the overall model, the Afrikaans, English and Sotho models emphasize and provide some evidence of the importance of parental involvement in promoting children's reading achievement.

Lastly, some interaction between parental time spent on reading and the opportunities created by parents for reading were repeatedly supported in a number of results with contrasting signs for models. While a theoretical distinction was made between these two factors for the purposes of this study, and in line with Creemers' Model of Educational Effectiveness, model results point to the possibility that these two factors may be related in reality and may result in the same parental behaviour either in spending time reading or creating opportunities for the child to read. It is therefore not possible to separate the effects of time spent on reading and opportunity created to read in the results of these models. This comment cautions against any associations of scores with time spent on reading, since non-significant coefficients for this factor cannot be interpreted in isolation and must be interpreted in conjunction with the opportunities created for reading and other realities in the model.