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Exploring Variables and Reading Achievement in Ireland: Insights from PIRLS 2021

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Introduction

- Given that reading and reading comprehension are foundational skills, it is vital that young children become proficient in reading (National Reading Panel, 2000). Based on the relatively strong performance of students in Ireland on PIRLS, we focus on the following research questions:
    1. **What are the most salient predictors of the achievement of students in Ireland on PIRLS?**
    2. **How do these predictors contribute to the performance of students in Ireland on PIRLS?**
- *As a collaborative international team, colleagues from the United States and Ireland examine the PIRLS data collected in Ireland to explore more fully the dimensions of the PIRLS framework and students' reading performance.

Ireland on PIRLS

Table 3.1: Mean reading achievement of countries in PIRLS 2021, with standard error (SE), standard deviation (SD), and position relative to the scale centrepoint

Assessed at end of Fourth grade (End G4)					Assessed at start of Fifth grade (Start G5)				
Country	**Mean**	**SE**	**SD**	**Vs centrepoint**	**Country**	**Mean**	**SE**	**SD**	**Vs centrepoint**
Singapore	587	3.1	86	^					
					Ireland	577	2.5	77	^
Hong Kong SAR	573	2.7	67	^					
Russian Federation	567	3.6	71	^					
					Northern Ireland	566	2.5	81	^
England ⋈	558	2.5	76	^					
					Croatia	557	2.5	69	^
					Lithuania	552	2.3	71	^
Finland	549	2.4	74	^					
Poland	549	2.2	72	^					
					United States*	548	6.8	87	^
Taiwan	544	2.2	69	^					
Sweden	544	2.1	79	^					
Australia ⋈	540	2.2	82	^					
Bulgaria	540	3.0	88	^					
Czech Republic	540	2.3	73	^					

Background

- Recognizing the importance of reading, the International Association for the Evaluation of Educational Achievement (IEA), an organization comprised of a variety of institutions, has worked to promote the Progress in International Reading Literacy Study (PIRLS).
- The PIRLS is an international comparative study, implemented every five years, focused on measuring reading performance for students aged 9-10 years old (Mullis & Martin, 2019). Using the IEA's view of reading as "the ability to understand and use those written language forms required by society and/or valued by the individual" (Mullins et al., 2016, p. 11), the PIRLS framework outlines two purposes of reading: literary experience and student's ability to acquire and use information.

Four Comprehension Processes

- The PIRLS assessment focuses on four comprehension processes within these two outlined purposes of reading (Mullis & Martin, 2021). These include:
  1. focus on and retrieve explicitly stated information
  2. make straightforward inferences
  3. interpret and integrate ideas and information
  4. and evaluate content and textual elements (Mullis et al., 2016).

Tension

- Although, scholars have raised concerns of the PIRLS assessment in terms of cross-cultural differences between countries as well as biases in the selection of students (Cordero et al., 2018; Marôco, 2021), countries continue to utilize PIRLS as an instrumental measure of assessing the reading skills and the contexts in which these skills develop (Stiff et al., 2023) and ultimately establish and implement educational policy around literacy development.
- Thus, understanding how and why some countries excel in various dimensions of the PIRLS may be critical in exploring how educational systems across countries may further support reading achievement in young children. Of particular significance is the case of Ireland in the PIRLS 2021 assessment cycle which scored higher (M =577) than most participating countries.
  - ***Note***. PIRLS was implemented at the beginning of Grade 5 in 2021 due to COVID, and, unlike other countries, Ireland administered the paper version of the test only. Nevertheless, on balance, Ireland has done well on recent PIRLS assessments.

Theoretical Framework

- This research was guided by Bronfenbrenner's (1977) ecological systems theory. Briefly, ecological systems theory (1977) considers how factors influenced within school structures are embedded within multiple nested systems ranging from the individual (i.e., personal characteristics such as beliefs about reading and literacy) and the micro- and meso-systems (the learning contexts within which students engage in and are positioned in within reading literacy classroom spaces) as well as the exosystems (larger macro politics which inform how literacy is taught within the Ireland school context) (Crawford et al., 2020).

Data & Participants

- **PIRLS 2021 - Ireland**
  - ✓*N* = 4,663 students from 148 schools in Ireland (unweighted; analyses were conducted after weighting).
  - ✓50.2% boys (*N* = 2,330), 48.0% girls (*N* = 2,227), 1.8% other (*N* = 86).
  - ✓82.5% (*N* = 3,850) reported that they always or almost always speak English at home, there were 14.6% (*N* = 679) and 2.1% (*N* = 96) who sometimes or never speak English at home.

Methods

Step 1 – Variable Selection - statistical support

- Elastic Net analysis

Step 2 – Variable Selection - theory and content support

- Expert review

Step 3 – Multilevel Modeling

Analysis – Step 1

Step 1 – Variable Selection/filtering using Elastic Net analysis

- **Variables**
  - ✓ **Outcome**: PIRLS reading achievement scores (5 PVs)
  - ✓ **IVs**: All variables collected from student, home, and school questionnaires (k=286 after excluding outcome, ID variables, and sampling weights)
    - ***Student***: sex, belonging to school, and students' engagement and confidence in reading, etc.
    - ***Home***: student early literacy and numeracy activities, parent's perceptions of child's school, etc.
    - ***School***: school's emphasis on academic success, and school environment, etc.
- All variables were standardized before analysis.
- Missing data were imputed using predictive mean matching (PMM).
- Analyses were conducted with sampling weights using each PV separately.
- R packages used: *mice*, *caret*, *glmnet*

Analysis – Step 2

Step 2 – Variable selection based on theory and content support

- **Review**
  - Content experts first reviewed all variables and ranked the importance of the variables.
- **Compare**
  - Content experts were given Elastic Net analysis results
- **Select**
  - The list of variables for MLM was finalized
- **Combine and create composites**
  - Create composites for variables measuring the same construct and/or with high correlations
  - Confirmatory factor analysis (CFA) or principal component analysis (PCA)
  - One composite variable was created using PCA (CFA model fit not satisfactory)
    - Emphasis on Reading Skills

Analysis – Step 3

Step 3 – Multilevel Modeling

- **Data screening** - Normality, multicollinearity
- **Missing data imputation** – Fully conditional specification
- **Variable centering**
  - **Outcome**: PVs of reading achievement
  - **IVs**: selected student (k=14), home (k=6), and school-level (k=8) variables
- **Model building**
  - Model 0 - Null/unconditional model
  - Model 1 – Random intercept model with student and home variables
  - Model 2 – Random intercept model with student, home, and school variables
  - *Note*. No interactions assumed.
- **Others**
  - Sampling weights included
  - Analysis for each PV, results then combined using multiple imputation with SE computed from measurement/imputing and sampling variance.

MLM Results – Overall Model Performance

Table 3 Multilevel Modeling Results

	Model 1 - Student & Home	Model 2 - Student, Home, & School
Variance Components		
School (between)	854.458	308.386
Student (within)	3361.865	3370.524
Model Fit		
ICC	0.20	0.08
Likelihood Ratio Test	F (21, 988.86) = 87.244, p < .001	F (7, 3483.90) = 23.171, p < .001
L1 R Square	0.36	0.36
L2 R Square	\	0.61

MLM Results – Student Variables

Variable	Est	SE	β	p	Interpretations
Sex (1 = Girl, 0 = Boy)	**6.47**	**1.71**	**3.89**	**<.001**	Girls performed better.
Speak English at home (1=never, 4=always)	-3.06	2.01	-2.50	0.16	no sig.
Internet connection at home (1=yes, 0=no)	**29.71**	**6.16**	**4.89**	**<.001**	Higher reading score with internet connection at home.
Absent from school (1=never, 5=once a week)	**-5.08**	**0.94**	**-5.52**	**<.001**	Lower reading score when more absent from school.
Belong at school (1=disagree a lot, 4=agree a lot)	**7.01**	**1.18**	**5.86**	**<.001**	Higher reading score when more belong to school.
Other students made fun of me (1=never, 5=once a week)	0.94	1.22	0.95	0.45	no sig.
Read Silent (1=never, 4=everyday)	**4.30**	**1.47**	**3.36**	**<.001**	Higher reading score when more read silently.
Selfchosen Book (1=never, 4=everyday)	**-2.75**	**1.27**	**-2.48**	**0.03**	Lower reading score when more selfchosen book.
Talk about what read (1=never, 4=everyday)	**-6.90**	**0.92**	**-7.80**	**<.001**	Lower reading score when talk about what read more often.
Borrow books from school or local library (1=never, 4=every week)	-1.63	0.91	-1.82	0.07	no sig.
Self efficacy in reading	-0.31	0.52	-0.56	0.56	no sig.
Engaged in reading lessons	**-2.35**	**0.63**	**-4.33**	**<.001**	Lower reading score when more engaged. [Positive but no sig. when looking at engagement and reading score alone.]
Disordely behavior in reading lessons (larger value, more disorderly behavior)	**-3.58**	**0.69**	**-5.84**	**<.001**	Lower reading score when disorderly behavior in more classes.
Like reading	0.07	0.68	0.14	0.92	no sig.
Confidence in reading	**11.91**	**0.54**	**24.53**	**<.001**	Higher reading when more confidence in reading.

β = standardized coefficients.

MLM Results – Home Variables

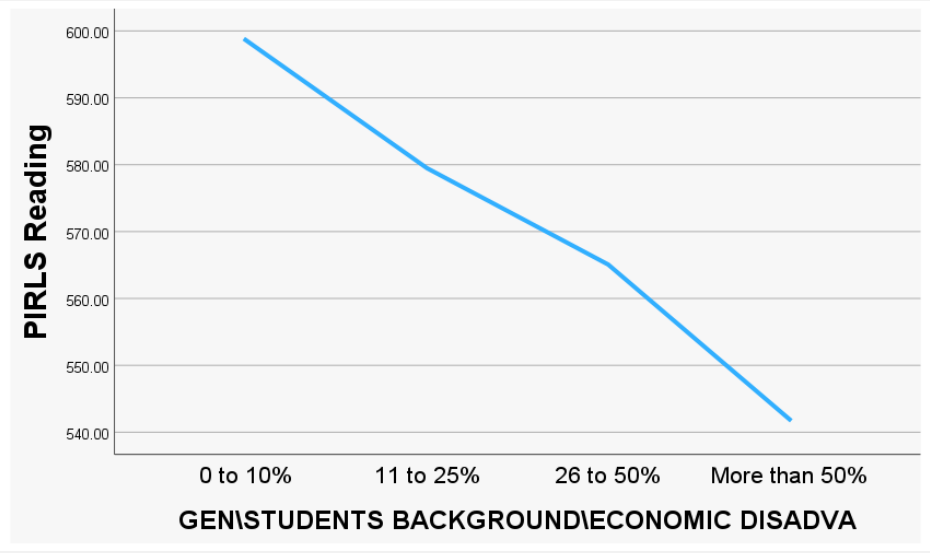
Variable	Est	SE	β	p	Interpretations
Home socioeconomic status	**6.75**	**0.76**	**12.88**	**<.001**	Higher reading score when higher home SES level.
Eearly literacy and numberacy activities before school	-0.59	0.57	-1.25	0.31	no sig.
Early literacy tasks	**8.50**	**0.76**	**15.35**	**<.001**	Higher reading when more early literacy tasks.
Parents perceptions of Child school	-0.54	0.56	-0.91	0.34	no sig.
Parents like reading	-0.59	0.55	-1.15	0.28	no sig.
Student attended preschool	**3.14**	**1.30**	**2.41**	**0.02**	Higher reading when stgudent attended preschool.

MLM Results – School Variables

Variable	Est	SE	β	p	Interpretations
Student economic disadvantage percentages (1=0-10%, 4=more than 50%)	**-13.25**	**2.13**	**-16.42**	**<.001**	Lower reading when school has higher disadvantge %.
Student economic affluence percentages (1=0-10%, 4=more than 50%)	1.15	1.78	1.40	0.52	no sig.
Have school library (1=yes, 0=no)	-0.31	3.68	0.15	0.93	no sig.
Instruction affected by a shortage or inadequacy (larger value, more affected)	**3.61**	**1.31**	**5.28**	**0.01**	Sligh higher reading when more affected. [Negative with trivial size when looking at it and reading alone.]
School emphasis on academic success	0.07	1.07	0.14	0.95	no sig.
School Discipline and Safety	**6.04**	**1.58**	**8.81**	**<.001**	Higher reading when school more disciplined and safe.
Emphasis on reading skills (larger value = earlier grade and emphasis on more skills)	3.20	1.76	3.37	0.07	no sig.

Discussion

- Examining these variables helps to outline some critical findings.
- Socioeconomic status has a strong impact on student achievement.
- Some variables seem to also contribute significantly- for example *belong at school, school discipline and safety.*
- School emphasis on academic success is not significant due to lack of variation – 80% of schools showed high and very high emphasis.



Next Steps

- Further explore these variables in relation to teacher data
- Innovative methods in variable selection
- Cross-level interactions (e.g., gender) in MLM
- Data from USA as a comparison
- Comparison with outcomes from other data sources (PISA, etc.)

Select References

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