Multilevel analysis of PIRLS 2006 data for Italy

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Abstract

Questionnaire Data from the PIRLS 2006 study in Italy provided a number of indices in order to summarize factors of educational context influencing reading achievement. The aim of the present secondary study is to explore the relationship between these indices at school as well as pupil levels and the Rasch-scaled score for overall reading achievement. A multilevel analysis was conducted using two levels, the home/student level nested under the school/teacher level following a four-stage procedure. Results show that pupils' attainment in reading is significantly related to home educational resources (home/student level effect), to the parents' attitudes toward reading (home/student level effect), to students' attitudes toward reading, to students' reading self-concept and to teacher career satisfaction (school/teacher level).

Keywords: *secondary analysis, reading achievement, multilevel regression, PIRLS 2006, background indices*

Introduction

The aim of the this study was to explore, for the Italian PIRLS 2006 data, the relationship between contextual factors (as summarized by international indices) at school as well as pupil levels and the Rasch-scaled score for reading achievement. The theoretical framework of the study was consistent with the PIRLS 2006 assessment framework (Mullis, Kennedy, Martin, & Sainsbury, 2006) which considers the multilevel structure of factors influencing reading literacy.

The results of the study provide an initial contribution towards understanding which variables at various levels affect reading performance in Italian children in 4th grade. This is necessary in the light of a series of initiatives planned by the Italian government intended to improve the reading skills of primary school pupils.

Methodology and Data Sources

Sample

Data is based on the answers of 3581 pupils (51.4% boys) in 4th Grade, as well as those of teachers and principals who took part in the PIRLS 2006 study in Italy.

Variables

Measurements were taken at home/student level and at school/teacher level. The dependent variable of the analysis was the Rasch-scaled score for overall reading achievement and the independent variables were the international indices (Martin, Mullis, & Kennedy, 2007) based on questionnaires for students, teachers, schools and parents. The indices used in this article are briefly described in the Table 1 below and details of their construction can be found in Martin, Mullis, and Kennedy (2007).

[Take in Table 1 about here]

In addition we considered the gender of the student (scored 1/0) to be an independent variable.

Analysis

First we looked at the reliability and discriminative power of indices in the Italian context: indices with a very low alpha value and low discriminative power were not considered for further analysis. Missing data were imputed using the SPSS 15.0.1 (SPSS Inc., 2006) missing values procedure. In order to develop and test a multilevel model (Hox, 2002) we used the strategy of randomly splitting the data file in two. The first random sample was used to develop a satisfying model and the second one to check the results found. The multilevel analysis was conducted using two levels, the home/student level and the school/teacher level. Home and student variables were modeled on the home/student level only, except for the Index of Home Educational Resources, which was aggregated at school level and assessed also at the second level as a contextual variable. The school and the teacher variables were modeled at both the home/student level and the school/teacher level. In considering the explorative purpose of the study only main effects were analyzed and interaction effects were ignored.

The process of analysis was carried out in four stages:

1. We analyzed a model with no explanatory variables (intercept-only model) to estimate the school intra-class correlation.

2. We analyzed a model with pupil level explanatory variables fixed to assess the contribution of each individual explanatory variable. We tested the improvement of the final model (the one with only variables significant at the 1% level) compared to the intercept-only model.

3. At step 3 we included the school/teacher level variables, removing from the model those which were not significant at the 1% level.

4. We assessed the final model developed at step 3 using the second random sample of the data file.

The data was analyzed according to the scheme presented in Figure 1.

[Take in Figure 1 about here]

Finding and Discussion

Results

Table 2 shows the reliability and Multiple R between student reading achievement and component variables of indices in the Italian context.

[Take in Table 2 about here]

The index of Reading for Homework (RFH) and the index of Home–School Involvement (HSI) both had a very low alpha value (Tab 2) and were therefore excluded from further analysis.

The intra-class correlation in school was 0.23, meaning that roughly 23% of the variance is attributable to school traits. The fixed model developed at stage 2 significantly improved the fitting when compared to the base model: the -2 Restricted Log Likelihood difference between the two models was 3098.12 (G.L. = 7) $p < 0.01$.

The fixed model showed that students perform significantly better ($p < 0.01$) if their home environment supports more literacy, their parents' attitudes toward reading are higher, students' reading self-concept is higher and students' attitudes toward reading are better. The results at stage 3 showed that the only index modeled at the school/teacher level to significantly improve the fitting was the Index of Teacher Career Satisfaction. Therefore the final model replicated in the second random sample included the effects of the indices at home/student level found (measured, seen, which manifested) at stage 2 and, at school/teacher level, teacher career satisfaction. Table 3 lists the indices included in the final model at

home/student and at school/teacher level. All the effects of the final model were replicated as significant in the second random sample used in Stage 4 of the analysis.

[Take in Table 3 about here]

Discussion and Conclusion

Despite the explorative nature of the analysis, we can examine various general factors that seem to contribute towards reading achievement in 4th graders in Italy. The only relevant factor at school/teacher level was Teacher Career Satisfaction, which is based on teachers' reports of satisfaction with their current teaching role and their career as a whole. This means that motivational factors concerning teachers could be the most important variable in the context of Italian schools, being more important than the availability of various other kinds of resources. The results at Home/student level confirm the importance of Home Educational Resources for students. It is interesting to note that students' perceptions of their own reading competencies, their attitudes towards reading and their parents' attitudes towards reading were all variables significantly affecting student performances. These findings can be read in the light of the Self-Determination Theory (SDT - e.g. Deci & Ryan, 2002), which proposes a conceptual framework for understanding the antecedents and consequences of student motivation.

According to the SDT self-determination is a central aspect of student motivation. It is considered essential for encouraging students to have an interest in learning, an idea of the importance of studying, and a feeling of confidence in their own abilities and personal characteristics. According to the SDT, self-determined students experience a sense of freedom in doing what they consider interesting, personally important and closely corresponding to their individual values and choices (Deci & Ryan, 2002). The SDT claims that students have a psychological need for self-determination (i.e. the perception of being the source of one's own behavior, Deci & Ryan, 2002) and that there are different types of regulation for student academic motivation, which reflect differences in their relative self-determination. These types of regulation can be placed along a Self-Determination continuum ranging from amotivation to extrinsic motivation as far as intrinsic motivation (Ryan and Deci, 2000). According to the STD model intrinsic motivation leads to the most self-determined form of behaviour. This type of regulation refers to: "*…doing an activity for its inherent satisfactions rather than for some separable consequence*" (Ryan & Deci, 2000, p3). Intrinsic motivation consists of doing something because it is interesting, pleasant and satisfying in itself (Ryan & Deci, 2000); when one is intrinsically motivated one undertakes an activity because one knows that one will enjoy it.

As regards the consequences of self-determined motivation, empirical studies (Deci & Ryan,

2002) have shown that differences in styles of regulation have implications for school achievement, thus the higher the level of self-determination, the better the results (e.g. Grolnick, Ryan, & Deci, 1991; Miserandino, 1996; Soenens & Vansteenkiste, 2005). As regards the antecedents of self-determined motivation several studies (e.g. Vallerand, Fortier, Guay, 1997; Hardre & Reeve, 2003; Soenens & Vansteenkiste, 2005) reveal a positive correlation between the attitudes and behavior of teachers who are supportive of their students' autonomous interests and self-determined motivation.

Considering the content of indices which proved to be significantly related to reading literacy, that is Students' Attitudes Toward Reading (e.g. I enjoy reading), Parents' Attitudes Toward Reading (e.g. I like to spend my spare time reading) and Teacher Career Satisfaction (e.g. I had more enthusiasm when I began teaching than I have now – reverse coding), one can see that these issues are close to the concept of self-determination proposed by the SDT.

Additionally, the content of the Students' Reading Self-Concept (e.g. Reading is very easy for me) could be also interpreted as an indication of the students' feeling of confidence in their own abilities, which is a factor considered to influence student self-determination (Deci & Ryan, 2002). To sum up, this secondary study shows that every variable which proved to be significantly related to reading literacy, except for a general factor such as Home Educational Resources, is strictly connected with the SDT theoretical model and seems to support it.

Finally, a few limitations of this study need to be mentioned. Firstly we have not yet tested the structure of relations between the indices that would be expected according the SDT. Indeed it seems plausible to suppose that the effect of parents' attitudes toward reading, teacher career satisfaction and students' attitudes toward reading, on reading literacy is significantly mediated by self-determination. In addition forthcoming analysis should examine further variables that are assumed to have an impact on reading literacy within the PIRLS conceptual framework and that were not considered in this study because they were not international indices.

It would also be useful to repeat the analyses conducted for other countries in the PIRLS dataset. This would allow us to see if the relationships found were confined to Italy alone, or if they had a more international relevance.

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Tables

Table 1. Description of international indices used as independent variables in the analysis (Martin, Mullis, & Kennedy, 2007)

INDEX	DESCRIPTION
Early Home Literacy Activities (EHLA)	Parents' reports about engaging in early literacy activities with the students before they began primary school. This index is based on parents' reports of the frequency with which they engage with their child in activities such as reading books, telling stories and playing word games, prior to entry into primary school.
Home Educational Resources (HER)	Students' and parents' reports about aspects of the home environment and the extent to which it supports literacy. This index is based on students' responses to two questions: number of books in the home, and educational aids in the home (computer, study desk/table for own use, etc.); and parents' responses to two questions: the number of children's books in the home and parents' education.
Parents' Attitudes Toward Reading (PATR)	Parents' preferences for reading. It is based on parents' agreement with statements such as: I read only if I have to, I like talking about books with other people, etc.
Parents' Perceptions of School Environment (PPSE)	Parents' perceptions of the schools' efforts to provide a supportive learning environment. It is based on parents' agreement with statements such as: my child's school includes me in my child's education, my child's school cares about my child's progress in school, etc.
Reading For Homework (RFH)	This index sums up teachers' responses to two questions: How often do you assign reading as part of homework (for any subject)? In general, how much time do you expect students to spend on homework involving reading (for any subject) each time you assign it?
Availability of School Resources (ASR)	Principals' reports of how much the school's capacity to provide instruction is affected by a shortage or inadequacy of resources, such as: qualified teaching staff , instructional materials, school buildings and grounds, computers for instructional purposes, library books, etc.

Home–School Involvement (HSI)	Principals' reports of the activities offered by their schools and parents' involvement in school activities. This index is based on principals' responses to questions about how often they hold parent-teacher conferences and communicate with parents about students' progress, and on parents' responses to questions about how often they attend meetings and events organized by the school.
Principal's Perception of School Climate (PPSC)	Principals' perceptions of various factors related to the social climate of the school. This index is based on principals' description of factors such as: teachers' job satisfaction, parental support for student achievement, students' regard for school property, etc.
Principals' Perception of School Safety (PPSS)	Principals' perceptions of the degree to which various problems (such as: classroom disturbances, vandalism, physical conflicts among students) occur in their schools.
Teacher Career Satisfaction (TCS)	Teachers' reports of satisfaction with their current position and career choice as a whole. This index is based on teachers' agreement with statements such as: I am satisfied with being a teacher at this school, I had more enthusiasm when I began teaching than I have now, etc.
Student Safety in School (SSS)	Students' perception of safety at school and their reports of incidents affecting safety. This index is based on students' agreement with the statement "I feel safe when I am at school" and reports of stealing, bullying and injury happening to the students themselves or someone in their class in the last month.
Students' Attitudes Toward Reading (SATR)	Students' reading preferences. This index is based on students' agreement with statements such as: I read only if I have to, I like talking about books with other people, I think reading is boring.
Students' Reading Self-Concept (SRSC)	Students' perceptions of their own reading competencies. This index is based on students' responses to statements such as: reading is very easy for me, when I am reading by myself I understand almost everything I read.

Table 2. Reliability and Multiple R of indices in the Italian context

Index	Cronbach's alpha between the component variables	Multiple R between student reading achievement and component variables
Early Home Literacy Activities (EHLA)	0.60	0.24
Home Educational Resources (HER)	0.62	0.32
Parents' Attitudes Toward Reading (PATR)	0.82	0.28
Parents' Perceptions of School Environment (PPSE)	0.55	0.17
Reading for Homework (RFH)	0.14	0.00
Availability of School Resources (ASR)	0.84	0.14
Home–School Involvement (HSI)	0.41	0.14
Principal's Perception of School Climate (PPSC)	0.76	0.14
Principals' Perception of School Safety (PPSS)	0.92	0.17
Teacher Career Satisfaction (TCS)	0.69	0.10
Student Safety in School (SSS)	0.68	0.14
Students' Attitudes Toward Reading (SATR)	0.69	0.32
Students' Reading Self-Concept (SRSC)	0.53	0.35

Table 3. Statistically Significant Effects at Home/Student Level and at School/Teacher Level

Index	Home/Student Level	School/Teacher Level
Gender of the student	N.S.	
Early Home Literacy Activities (EHLA)	N.S.	
Home Educational Resources (HER)	*	N.S.
Parents' Attitudes Toward Reading (PATR)	*	
Parents' Perceptions of School Environment (PPSE)	N.S.	
Availability of School Resources (ASR)	N.S.	N.S.
Principal's Perception of School Climate (PPSC)	N.S.	N.S.
Principals' Perception of School Safety (PPSS)	N.S.	N.S.
Teacher Career Satisfaction (TCS)	N.S.	*
Student Safety in School (SSS)	N.S.	
Students' Attitudes Toward Reading (SATR)	*	
Students' Reading Self-Concept (SRSC)	*	

Empty cell= the effect was not modeled

N.S. = not statistically significant at p=0.01

* = statistically significant effect at p=0.01

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Figures

Figure 1. Data analysis scheme