Attitudes, teacher strategies and achievement[36]

Paulo A. Meyer M. Nascimento

Instituto de Pesquisa Econômica Aplicada – Ipea.

Britta Kilian

Department of Educational Psychology, University of Mannheim, Germany.

Kevin Isaac

Ministério da Educação da Alemanha.

36. The work presented hereafter is the product of reflections and analyzes started by the authors in October 2008, during the workshop "Working with Large Scale Assessment Data", and elaborated throughout six months after that. The workshop was organized by the Research Data Center (FDZ) at the Institute for Educational Progress (IQB), in Berlin (Germany), and conduced by Eugene Gonzalez, Leslie Rutkowski and Knut Schwippert. The authors are thankful to all of them, for the insights into PIRLS and into relevant methodological issues in working with large scale assessment data, as well as for motivating the participants to deepen their initial analyzes, produce a paper presenting the results and publish it. These people and institutions contributed considerably to make this work possible. Remaining errors are exclusively attributed to the authors.

Introduction

International evidence on the relationship between reading achievement and attitudes towards reading mostly shows a positive association between one and another. If that is the case, one could intuitively consider strategies adopted by teachers in the classroom as a way to motivate their students to read more and thus enhance their learning and boost student reading scores.

This paper examines associations between students' attitudes towards reading, instructional strategies adopted by their teachers in the classroom, and reading achievement observed for the German sample at the 2006 edition of the Progress in International Reading Literacy Study – PIRLS 2006. Using internationally recognized large scale assessment data and relevant literature, the present article tests aspects of Walberg's model of chief productivity factors in school learning (REYNOLDS; WALBERG, 1992; WALBERG, 1981, 1986), in an attempt to draw some trends that might be useful for future research in Germany and abroad.

The coming sections are structured as follows: section 2 highlights the relevant literature on student attitudes, teacher strategies and achievement, and the Walberg's model of educational productivity; section 3 presents the hypotheses to be tested, the databased to be used and the limitations of the present study; section 4 details the adopted multilevel model, its variables and results; section 5 concludes.

Literature Review

Attitudes towards reading and reading achievement

Several researchers have examined the relationship between attitudes towards reading and reading achievement, many of them finding positive associations. For example, Walberg and Tsai (1985) examine various student related, instructional and environmental correlates of reading achievement and find attitude towards reading related to reading achievement. Within most countries a positive relationship between reading achievement and attitudes towards reading was found for the PIRLS 2001 dataset (GNALDI *et al*., 2005). Using another dataset, Wigfield and Asher (1984) report that better readers have more positive attitudes toward reading compared to poor readers. Sainsbury and Schagen (2004) find attitudes to reading generally positively associated with achievement in England, but declining somewhat between younger and older age groups.

However, the expected positive association between attitude towards reading and achievement in this subject is not always found. Paradoxically, some high achievers report poor attitudes toward reading (MULLIS *et al*., 2003). In

other studies, reading attitudes of good readers did not exceed those of poor readers (LAZARUS; CALLAHAN, 2000; MARTÍNEZ; ARICAK; JEWELL, 2008; RUSS, 1989). Swalander and Taube (2007), as well as Worrel, Roth, and Gabelko (2006), find consistent gender differences in attitudes towards reading - girls tend to report more positive reading attitudes than boys.

Regarding specifically the data available for PIRLS 2001, Gnaldi *et al.* (2005, p. 103) express "some concerns about the interpretation of results from the study, suggesting a more complex picture than that presented in the summary index published in 2003", as their secondary analysis of the attitude and achievement data from PIRLS for English students "shows that students with low ability levels have misunderstood the questions which tested their attitudes towards reading". This drove the results for English students to the opposite direction of the majority of assessed countries – i.e. "children in England were reported as having poor attitudes to reading, compared to children in many other countries, despite high achievement on the reading tests" (GNALDI *et al.*, 2005, p. 103).

Trying to elucidate the causal relationship between attitude and achievement, some researchers argue that attitudes towards reading influence students' motivation to read and the amount of time they spend reading and subsequently influence reading achievement (MARTÍNEZ; ARICAK; JEWELL, 2008). In line with these assumptions, Kush, Watkins, and Brookharta (2005) find a positive relationship between reading attitude in second and third grades and reading achievement in seventh grade. Similarly, Martinez *et al.* (2008) show that reading attitude predicted reading achievement four months later.

Given such literature, we shall expect students' attitudes to be positively associated with their reading achievement. What about teachers' strategies? Would quantity and quality of instruction be associated with achievement?

Teacher strategies, students' attitudes and reading achievement

Recent research suggests that individual teachers generate differential effects on student outcomes (KUKLA-ACEVEDO, 2009; HANUSHEK; RIVKIN, 2012).

Connor *et al.* (2009) use hierarchical linear models to assess the effects of instruction on students' reading comprehension and conclude that such relationship is highly complex, varying substantially across grades and dependent on students' vocabulary and oral reading fluency skills.

Trying to disentangle this complexity, it will be argued in the present paper that two components by which teachers can affect students' reading achievement are the quantity as well as the quality of language and reading instructions in the classroom.

Theoretical models of schooling (e.g. CARROLL, 1963; WILEY; HARNISCHFEGER, 1974) have early on stressed that time is an important determinant of learning. Three time-related variables have been identified that seem important throughout different models: (a) time allowed or allocated for learning (b) time spent or engaged in learning and (c) time actually needed for learning (GETTINGER, 1985). For example, in his model of school learning, Carroll (1963) proposed that school learning is a function of the time a student actually spends learning in relation to the time he or she needs to spend. The time spent on learning depends on the time that classroom teachers make available for learning as well as the amount of time students are actually on task.

Whereas it is difficult for teachers to change some of the important time-related variables (e.g. the time needed for learning), teachers can – within certain organizational and curriculum-related constraints - influence the time they allocate for learning and thereby affect student's school achievement. Hence we expect that teachers can affect students' reading achievement through the amount of time they devote to both instruction and activities in reading.

Empirically supporting Carroll's model, Gettinger (1985) find the expected influence of time allocated and time needed on reading achievement for a sample of fourth- and fifth-grade students. Empirical findings have been quite inconsistent though, some reporting strong relationships between time and learning outcomes, whereas in others this relation has been only minimal (LYON; GETTINGER, 1985). Lyon and Gettinger (1985) suppose that this inconsistency is based on a great variability of indexes researchers used for *time spent on learning* as well as for *achievement*, and on the neglect by some researchers of the variable *time needed for learning*.

Another possible explanation for the inconsistency observed for the relationship between time teachers make available for learning and students' achievement is that it does not only depend on the *quantity* but also on the *quality* of the instructional methods that teachers use. Studies have found effects of quality of instruction on students' achievement, some of them being indirect and mediated by students' motivation (e.g. KEITH; COOL, 1992).

Using data from the US Early Childhood Longitudinal Study, Palardy and Rumberger (2008) find instructional practices as more robustly associated with achievement gains than, for example, teachers' background qualifications. The question remains, however, what *quality of instruction* means.

In order to describe a teacher as successful, Klusmann *et al*. (2008) summarize four aspects of instructional behavior that are related to students' learning outcomes. First, successful teachers establish a well-structured environment in which time can be efficiently used. Second, teachers foster students' cogni-

tive activation in order to enable them to get new insights and understandings. Third, they neither overtax nor underestimate their students by proceeding at an appropriate pace. Fourth, teachers create a supportive social environment.

Direct measures of instructional practices, such as classroom observation, would be preferable to measures generated by teacher surveys (PALARDY; RUMBERGER, 2008). Still, a number of large-scale studies employing national databases find significant associations between student achievement and measures of instructional practices (see PALARDY; RUMBERGER, 2008, for a more extensive literature review on the matter).

For the purpose of the present study, individualized strategies, i.e. teachers using individualized instructions for different students and allowing them to work independently on a goal they chose by themselves, are conceptualized as proxies for *quality of instruction*. Using individualized instructions for students with different achievement levels ensures that the number of students either overtaxed or underestimated is as small as possible (KLUSMANN *et al*., 2008) and allows most of the students to be in the region of proximal learning (KORNELL; METCALFE, 2006). Furthermore, having students working on individualized reading tasks rather than doing the same task should foster learning goals – not necessarily performance goals, as group comparisons are less plausible when each student is working on a different task (ELLIOTT; DWECK, 1988). Since learning goals are seen as adaptive for achievement because they are positively associated with intrinsic motivation, interest, and persistence (WITKOW; FULIGNI, 2007), this teacher strategy should be positively related to students' reading achievement.

In addition to their main effect on reading achievement, we expect the quantity and quality of teacher instruction to moderate the relationship between students' reading attitudes and achievement. We expect the association between attitude and achievement to be stronger when teachers do not use appropriate instructions because in this case reading achievement should mostly depend on the student, particularly on his attitude and willingness to make progress in reading even outside the classroom. On the other hand, in classes in which the teacher spends a considerable amount of time on high quality reading instruction and activities, the association between attitude and achievement should be smaller.

Walberg's model of productivity factors

As described above, the present paper tries to scrutinize the associations between students' attitudes towards reading, teachers' strategies and students' reading achievement. However, focusing on these factors does not hold other inputs back on the school learning process. It is rather acknowledged that antecedents of students' reading achievement are numerous and complex.

Several research efforts have focused on identifying factors that are linked to the achievement and attitude scores of students. We apply in this paper the Walberg's model of productivity factors (reported by WALBERG, 1981, 1986; WALBERG; TSAI, 1985; FRASER *et al.*, 1987; REYNOLDS; WALBERG, 1992), a 9-factor model of educational productivity, which incorporates a set of factors that consistently have predicted student outcomes in past research. These factors, which are derived from Cobb and Douglas theory of national economic productivity (COBB; DOUGLAS, 1928), are divided into three sets, as follows in Table 1.

Table 1 - Walberg's Model of Productivity Factors

Set of factors	Productivity factor
A. APTITUDE	1. Student ability or prior achievement
	2. Motivation
	3. Age or developmental level
B. INSTRUCTION	4. Quantity or amount of time
	5. Quality or appropriateness for the student
C. PSYCHOLOGICAL ENVIRONMENT	6. Classroom climate
	7. Home environment
	8. Peer group
	9. Exposure to mass media outside of school including television

Adapted from: Reynolds and Walberg (1992), p. 307.

Regarding this model, Reynolds and Walberg (1992, p. 307) state:

> [It] hypothesizes that psychological attributes of individual students and their psychologically proximate environments influence cognitive, behavioral, and attitudinal outcomes of education. This specification was based on the consistency of results of statistically controlled analyses of large surveys and quasi-experimental (and experimental) studies in which students were assigned (randomly in experimental studies) to particular teaching and other methods and control groups. The two approaches offer complementary strengths.

Hypotheses, Database and Limitations

Hypotheses to be tested

Hypothesis 1: German students' attitudes are positively associated with their reading achievement.

Hypothesis 2: Teacher strategies are positively associated with German students' reading achievement.

Hypothesis 3: Teacher strategies perceived as desirable (undesirable) shrink (amplify) the correlations between German students´ reading attitudes and their reading achievement.

These hypotheses derive from the literature review presented in the previous section.

It should be noted that hypothesis 2 relates to possible *main effects* between teacher strategies and reading achievement, whereas hypothesis 3 refers to a potential *cross-level moderation/interaction effect* between one and another. It is thus assumed in hypothesis 3 that the relationship between attitude (A) and achievement (B) depends on the value of a third variable (C, teacher strategies), which is, in its turn, expected to be positively associated with achievement, too. Therefore, classes where teachers use desirable strategies may present smaller correlation between attitudes and achievement. That does not mean that achievement is lower in these classes, it only says that achievement depends less on attitudes in these classes. Mathematically, this demands predicting the slopes between attitude and achievement in different classes with teacher strategies.

These hypotheses will be tested by a multilevel model that tries to incorporate eight out of the nine chief productivity factors in school learning specified in Table 1. The data used in the model comes from the questionnaires and results obtained for German students by PIRLS 2006.

The database: PIRLS 2006

PIRLS 2006 is a second stage of a cycle of international reading literacy studies designed to monitor students' reading achievement at fourth grade in various countries every five years. It was conducted for the first time in 2001 and is planned and operated by the IEA (International Association for the Evaluation of Educational Achievement), a cooperative of research institutions and governmental agencies from various countries. Since its formation, in 1959, IEA has been organizing many comparative studies of student achievement in different school subjects such as Mathematics, Science, and Technology. The aim of these comparative studies is to inform policy makers, educators, researchers, and practitioners about educational achievement and learning contexts (MULLIS *et al*., 2003).

PIRLS 2006 was administered in 40 countries, some of which considered as more than one participant due to peculiarities of their educational systems. In total, 45 participants were assessed by PIRLS 2006. Participation in PIRLS is voluntarily and subject to each country, depending on their data needs or resources (MARTIN *et al*., 2007).

For the purposes of PIRLS, the literary experience could be defined as "the ability to understand and use those written language forms required by society and/or valued by the individual. Young readers can construct meaning from a variety of texts. They read to learn, to participate in communities of readers, and for enjoyment" (MULLIS *et al*., 2003, p. 33). PIRLS 2006 aimed at assessing two major reading purposes: literary experience and the acquisition and usage of information. These two major reading purposes were assessed in PIRLS 2006 based on separate reading passages, which were carefully prepared to be of interest for boys and girls enrolled in the fourth-grade. Each passage was followed by questions, half of them in a multiple-choice format, whereas the other half were in open-ended format (MARTIN *et al*., 2007).

Additionally, PIRLS 2006 collected a wide range of variables that might be associated with students' reading achievement such as students' reading behaviors and attitudes, students' early literacy activities, and home as well as school environments. Therefore questionnaires were not only designed for and administered to students, but also to their parents, teachers and school principals.

PIRLS 2006 consisted in fact of five different questionnaires (KENNEDY, 2007):

- *PIRLS 2006 Reading Curriculum Questionnaire*: completed by PIRLS National Research Coordinator within each country to collect some basic information on the defined national or regional curriculum in fourth grade;

- *PIRLS 2006 Learning to Read Survey*: students' parents or caregivers were asked about children's early literacy activities, home resources, parents reading behavior, attitudes etc;

- *PIRLS 2006 Student Questionnaire*: filled in by students with information about their reading behaviors and attitudes.

- *PIRLS 2006 Teacher Questionnaire*: administered to the teachers of assessed classes, inquired about classroom organizations and instructional approaches, as well as teachers' professional preparation and experience. Finally,

- *PIRLS 2006 School Questionnaire*: school principals completed this instrument, designed to identify overall school policies and resources.

PIRLS assesses students after four years of schooling. The fourth grade is seen as a crucial point in children's development as readers "because most of them should have learned to read, and are now reading to learn" (MARTIN *et al*., 2007, p. 15). In some countries, students were surveyed at fifth grade as an exception due to early entry to primary school – as IEA policy does not recommend assessing children under the age of 9 with paper-pencil-surveys such as PIRLS. All students were assessed in their language of instruction at school, which required an extensive iterative translating and reviewing pro-

cess of tests and questionnaires. Data were collected between April and June of 2006 for most countries (MARTIN *et al*., 2007).

Several characteristics of students and their environments assumed to influence reading achievement were controlled for in the present study. As a consequence, information from four out of five PIRLS instruments was used to build the model: *PIRLS 2006 Student Questionnaire*, *PIRLS 2006 Teacher Questionnaire*, *PIRLS 2006 Learning to Read Survey* and *PIRLS 2006 School Questionnaire*.

Limitations of this study

Causal relationships are hard to be identified, especially in social sciences, as reverse causality is possible to occur. In the case of attitudes towards reading and reading achievement, for example, these two variables are linked to each other so closely that it would be hard to figure out whether positive attitudes towards reading influence reading achievement or in reality the latter affects the former. Any attempt to establish causal links between teachers' strategies and students' attitudes or reading achievement is likely to incur in the same methodological problem, as reverse causality may also arise here.

This methodological constraint is often referred to as the *endogeneity problem* – the term *endogenous* is used because the variable "attitudes towards reading" is not exogenous to the model, but is rather likely to be at least partly determined by the outcome variable (reading achievement) it aims to explain. This problem is ideally overcame by *randomized controlled trials*, which are rare in education due to ethical issues and are difficult to replicate, or *natural experiments*, occasional and externally-imposed situations that generates exogenous variation in context variables, although usually circumscribed to specific contexts and/or geographical regions (NASCIMENTO, 2012) – thus they are virtually impossible to count with in cross-country analyses.

Alternatively, the effects of the endogenous variable on the outcome variable might be isolated by a statistical treatment that uses vectors (measures or group of measures with particular common characteristics) strongly correlated with the endogenous variable, but not directly related to the outcome variable (WOOLDRIDGE, 2009) – this method is known as the *instrumental variable approach* and resembles natural experiments. *Propensity matching scores*, which compares groups whose members present similar characteristics, but only one group receives a "treatment" (benefits from a specific program or policy, for example), is also an econometric technique that can be used to tackle the endogeneity problem in educational studies (NASCIMENTO, 2012).

Longitudinal data potentially reduces methodological issues raised by the endogeneity problem, as long as a baseline assessment is used to adjust for the

fact that prior achievement may motivate students to adopt positive attitudes towards reading and thus achieve higher scores in future Reading tests. This point of view follows analogously the arguments of an established line of research on the effects of class sizes on student achievement, led by Harvey Goldstein and Peter Blatchford (e.g. BLATCHFORD *et al*., 2002, 2008; GOLDSTEIN; BLATCHFORD, 1998), for whom "a longitudinal design with baseline assessment […] adjusts for possible purposive or non-random selection of children into classes on the basis of their pre-existing achievement" (BLATCHFORD *et al*., 2002, p. 171).

When reverse causality is likely to arise, longitudinal data are not available and none of the techniques mentioned above are possible to be used, one can at most argue that the explaining variable of interest seems to be *associated* with the outcome variable – no inferences on causal paths or possible effects should be made.

The present study uses PIRLS 2006 data for German students to assess potential associations between students' attitudes, teachers' strategies and students' reading achievement. It does not attempt to look for any causal relations linking these three factors, as either the search for identification or the calculation of propensity scores demands methodological procedures that exceeds the purpose of this paper. Neither randomized controlled trials nor natural experiments are available to isolate the effects of one on another. On top of that, as Brooke (2005) points out, once-only measures of achievement (e.g. PIRLS performance data) are unable to examine learning growth – what requires longitudinal data assessing a cohort of students, as argued before.

In spite of the limitations of the present analysis, this work has the strength of dealing with the nested nature of educational data, allowing for between-student, between-classroom and between-school variations. In other words, multilevel models take into account intraschool correlations in students' responses (STEELE; VIGNOLES; JENKINS, 2007) – addressing, therefore, a major concern discussed in relevant literature (GOLDSTEIN, 2011; RAUDENBUSH; BRYK, 2002; SNIJDERS; BOSKER, 1999). Moreover, the methodological issues described above do not object testing the three hypotheses presented in the previous section.

Model and Results

In an attempt to test the entire Walberg model using PIRLS 2006 data for Germany[37], the available questionnaires were scanned in search for appropriate items or group of items to be used as proxies for each productive factor. As a result, an initial set of over 30 variables were listed – see Table 2 (the charac-

37. The only productivity factor shown in Table 1 for which no measures were tested in the present article was age or developmental level, due to common understanding among authors that age-grade distortion is not relevant in the German context.

ters into brackets refer to the names attributed to the variables in FOY; KENNEDY, 2008, 2008):

Table 2 - Variables Initially Identified in PIRLS 2006 Dataset to Test Walberg's Model

	Productivity factor	PIRLS 2006 variable label (and variable name)
A. APTITUDE	1. Student ability or prior achievement	1.a. Index of students' reading self-concept (ASDGSRSC)
		1.b. Parents on child's early literacy skills (ASDHAIB)
		1.c. Estimates of the Percentage of Students Entering School Able to Perform Beginning Literacy Skills (ACDG1GR)
	2. Motivation	2.a. Index of students´ attitudes towards reading (ASDGSATR)
		2.b. Students' Reports About Independent Reading (ASDGTHC2)
	3. Age or developmental level	3.a. Month and year of birth (ASBGBIRM and ASBGBIRY)
		3.b. Number of students in class that are in fourth grade in relation to total number of students in class (ATBG4STD / ATBGCSTD)
B. INSTRUCTION	4. Quantity or amount of time	4.a. Percentage of instructional time devoted for reading instruction (RCQ12B) – due to lack of data availability for RCBQ12B in the German database, it was replaced later on by *time for language instruction*, either measured in hours (ATBGACTH) or in minutes (ATBGACTM)
	5. Quality or appropriateness for the student	5.a. Teachers use a variety of organizational approaches (ATDGRA) - dummy
		5.b. Areas of emphasis in teachers´ formal education and training (ATDGEAR and ATDGAEFE)
		5.c. Use of fiction for reading instruction (ATDGRTXF) – dummy
		5.d. Use of non-fiction for reading instruction (ATDGRTXN) – dummy
		5.e. Index of reading for homework (ATDGRFH)
		5.f. Remedial reading specialist available (ATDGDIF1)
		5.g. No Access to Any Specialist (ATDGDIF2)
		5.h. Index Teacher Career Satisfaction (ATDGTCS)
		5.i. Teachers' experience in number of years teaching fourth grade (ATBG4TOT)
		5.j. Index of Availability of School Resources (ACDGASR)
C. PSYCHOLOGICAL ENVIRONMENT	6. Classroom climate	6.a. Index of Principals' Perception of School Climate (ACDGPPSC)
		6.b. Index of Principals' Perception of School Safety (ACDGPPSS)
		6.c. Index of Student Safety in School (ASDGSSS)
		6.d. Index Students' Perception School Climate (ASDGSPSC)
		6.e. Index of Parents' Perceptions of School Environment (ASDHPPSE)
		6.f. Index of Home-School Involvement (ACDGHSI)
	7. Home environment	7.a. Index of Home Educational Resources (ASDHHER) – OBS: includes parental education
		7.b. Index of early home literacy activities (ASDHEHLA)
		7.c. Index of parents´ attitudes towards reading (ASDHPATR)
		7.d. Parents' Employment Situations (ASDHPEMP)
		7.e. Parents' Occupational Level (ASDHOCCP)
	8. Peer group	8.a. Students' reports about students reading aloud in class (ASDGTHC)
	9. Exp. mass media outside of school including TV	9.a. Students Reading for Information Outside of School (ASDGINFR)
		9.b. Time spent watching television or videos outside of school on a normal school day (ASBGTSP1)

Source: Authors's own elaboration.

However, a model with such a large number of variables was revealed unproductive. Let alone possible bias raised by multicollinearity, the analysis could be harmed by the reduced number of observations remaining for all those variables. For that reason, missing data analysis have been carried out to get to a solution without a detrimental loss of too many classes (N=318 classes with N=6389 individuals). One methodological way to remedy these constraints is multiple imputation of missing data (ALLISON, 2001; GELMAN *et al*., 1995; LITTLE; RUBIN, 1987; SCHAFER, 1997). Another possibility is to narrow down the repertory of variables considering theoretical assumptions. The latter seemed to be a more ecological approach considering the use of five plausible values[38] as the dependent variable. Only variables with less than 20% missing values have been used in the present study with respect to the loss of observations if they were combined together.

38. Plausible values are multiple imputations of the unobservable latent achievement for each student, usually calculated for large-scale assessment programs (WU, 2005) – such as PIRLS 2006.

Besides, the need to control separately for different aspects of home environment replaced the *index of home educational resources* (ASDHHER) by three of its components, namely *parents' highest education level*, *books at home* and *students' parents born in country*. These individual indicators seemed to outrun ASDHHER completely, justifying their use instead of including the composite index in the model.

Student-level variables which were decided to be further analyzed are shown in Table 3, while class-level variables are shown in Table 4.

Table 3 - Predictor variables on the individual level

Walberg's productive factor	*Variable name*	*Variable label*	*mean (sd)*
A1	SRSC	Index of Students' Reading Self-Concept	0.48 (0.56)
A1	G1GR[5]	Principals' Estimates of the Percentage of Students Entering School Able to Perform Beginning Literacy Skills	2.76 (0.53)
A1	HAIB	How Well Students Could Perform Beginning Literacy Activities When They Entered School	1.56 (0.96)
A2	SATR	Index of Students' Attitudes Toward Reading	0.53 (0.64)
A2	INFR	Students Reading for Information Outside of School	1.48 (0.89)
A2	THC[2]	Students' Reports About Independent Reading	0.58 (0.81)
C6	GENDER[1]	Sex of the student	0.51 (0.50)
C6	PPSE	Index of Parents' Perceptions of School Environment	0.56 (0.59)
C6	SSS	Index of Student Safety in School	0.54 (0.57)
C7	SES2	Parents Highest Education Level	1.88 (1.13)
C7	BOOK[3]	Books at home	1.87 (1.20)
C7	PBC[4]	Students' Parents Born in Country	0.43 (0.74)
C7	PATR	Index of Parents' Attitudes Toward Reading	0.50 (0.65)
C7	HEHLA	Index of Early Home Literacy Activities	0.53 (0.65)
C8	THC	Students' Reports About Students Reading Aloud in Class	2.16 (0.97)
C9	GTSP1[5]	Time spent watching TV	1.69 (1.01)

Source: PIRLS 2006 microdata.

Note. All categorical variables have been recoded to get a meaningful zero category

[1] derived from ITSEX: boys (1), girls (0)

[2] derived from ASDHEDUP

[3] recoded: more than 200 (0), 101-200 (1), 26-100 (2), 11-25 (3), 0-10 (4)

[4] derived from ASDGBRN

[5] inversed original scale, - G1GR: high (3)=less than 25%, low (0)=more than 75%; GTSP1: high (4)=watching television 5 hours ore more per day, low (0)=no time

Table 4 - Predictor variables on the class level

Walberg's productive factor	*Variable name*	*Variable label*	*Mean (sd)*
A1	SRSC3	Index of Students' Reading Self-Concept (classmean)	0.48 (0.17)
A2	SATR3	Index of Students' Attitudes Toward Reading (classmean)	0.55 (0.22)
B4	ACT4	How often do you have reading instruction and/or do reading activities?	1.47 (0.69)
B5	ASR	Index of Availability of School Resources	0.28 (0.48)
B5	TAGE1	Age of teacher	2.21 (0.97)
B5	TGENDER2	Sex of teacher	0.10 (0.31)
B5	RFH	Index of Reading for Homework	1.05 (0.35)
B5	TCS	Index of Teacher Career Satisfaction	0.35 (0.49)
B5	GRAO4	Quality of instruction ("self organized learning")	1.10 (0.64)
B5	GRAO6	Quality of instruction ("individual instruction")	1.09 (0.79)
B5	DIF1NEG5	Remedial Reading Specialist Available	0.46 (0.58)
C6	PPSC	Index of Principals' Perception of School Climate	0.75 (0.47)
C6	PPSS	Index of Principals' Perception of School Safety	0.47 (0.54)
C6	HIS	Index of Home-School Involvement	1.24 (0.79)
C6	BOYS	Percentage boys in class	0.51 (0.12)
C7	CLASSES3	Parents Highest Education Level (classmean)	1.92 (0.54)

Source: PIRLS 2006 microdata.

Note. All categorical variables have been recoded to get a meaningful zero category

[1] recoded: 25-29 years (0), 60 or more (4)

[2] recoded: female (0), male (1)

[3] aggregated from individual level

[4] inversed original scale, - time for reading instr/reading activities: every day (2), fewer 3x/week (0)

[5] inversed original scale, - high (2): always, somethimes (1), low (0): never

As a first modeling step, variance components were examined utilizing a one-way ANOVA with random effects (RAUDENBUSH; BRYK, 2002). An useful parameter from this fully unconditional model is the *intraclass correlation* (ICC), i.e. the correlation among units within the same group (GELMAN; HILL, 2007). As Snijders and Bosker (1999, p. 151) point out, "in most social science research, the intraclass correlation ranges between 0.0 and 0.4". It is worth noting, however, that "the greatest the correlation among units within a group (that is, the bigger ICC is), the greater the impact on the standard error" (GELMAN; HILL, 2007, p. 448). In the present case, an ICC of .35 was found,

indicating a considerable amount of variance between classes. As a consequence, the nested nature of the data had to be taken into consideration with a hierarchical linear modeling approach – otherwise standard errors tend to be overestimated, resulting in underestimated statistical significance for potential level-2 effects (LEE, 2000).

The second step consisted in analyzing individual level predictors separately for varying slopes. Significant individual level predictors were modeled with randomly varying slopes within classes. Those that were significant but presented no varying slope variances were included in the model, assuming they generate a common effect for all classes. Every predictor variable has been recoded in a fashion that the lowest value indicates a meaningful zero point acting as a reference category. Therefore, high values can be interpreted in a way expressing a reciprocal ratio to achievement. For accurate reflection of population attributes in analyses based on PIRLS sample data, it is necessary to take the design of the sample into account. This is typically accomplished by weighting the respondent by a previously assigned sampling weight in all analyses. The *Student House Weight*, which was designed for use in student--level analyses, was then applied.

A series of analysis steps have been carried out to build a level 1 model with statistically significant predictor variables. Table 5 provides estimated within--class parameters of the final model with random effects.

Table 5 - Random Coefficient Model

	Fixed Effects				Random Effects3		
	B	se	t Ratio	p	sd	Variance	p
Intercept	596.48	4.02	148.39	.000	21.06	443.36	.000
SES[1]	-1.04	1.20	-8.36	.000			n.s.[2]
Books at home	-6.83	1.19	-5.72	.000			n.s.
Students' Parents Born in Country (PBC)	-13.00	1.88	-6.92	.000	9.51	90.49	.002
Index of Students' Reading Self-Concept (SRSC)	-22.37	2.23	-1.02	.000			n.s.
How Well Students Could Perform Beginning Literacy Activities When They Entered School (HAIB)	-3.38	1.07	-3.16	.003			n.s.
Students Reading for Information Outside of School (INFR)	5.54	1.62	3.42	.003			n.s.
Index of Students' Attitudes Toward Reading (SATR)	-14.08	2.49	-5.65	.000	15.30	233.92	.014
Index of Student Safety in School (SSS)	-13.38	2.79	-4.79	.000	10.11	102.16	.028

[1] Parents' Highest Education Level: centered at its grand mean

[2] n.s. = not significant

[3] *df* = 261, Level-1 effect variance δ^2 = 1958.53

As can be seen from Table 5, students' attitudes towards reading, as well as reading self-concept, have a significant effect on reading achievement. As ex-

pected, increasing disagreement by one unit on the attitude index yields a decrease of 14 points on the PIRLS logit metric. Accordingly, a low self-concept yields to poor achievement (b=-22.37 points). It is worth mentioning that these effects are present even under statistically controlled SES ("*Parents Highest Education Level"* as proxy variable), educational level (represented by "*Books at Home*") and school safety. Thus, hypothesis 1 that assumed more positive attitudes towards reading to be associated with high reading achievement was supported. The result for the predictor *reading outside of school* seems to be counterintuitive and conflictive with common theory: scores appeared to be slightly better (b=5.5) for those students who tend to read less outside of school.

Table 5 also displays the results for significant residual variation in the slopes after controlling for every level 1 variable. The x^2 test statistics suggests significant variation in the slopes of *parents' migrant background* (PBC), *attitudes toward reading* (SATR) and *student safety in school* (SSS). With this set of predictor variables 39 percent of the parameter variation at the student level could be explained, as well as 10 percent of the slope variance.

For the variable s*tudents' reports about independent reading*, it was observed a varying slope but no significant coefficient was found. Interpretation of this constellation will be difficult but interesting: this variation can possibly be explained by any other variable. However, after including every variable of interest at the individual level, the slope variation of this variable disappeared.

Hypotheses concerning class level associations (primarily teacher variables) have been modeled independently in a third step – extending the final random coefficient level 1 model. Controlling for SES at class level and thus assuming compositional effects lead to non significant effects in any teacher variable. One explanation could be the use of the five plausible values, incorporating a somehow complex background model. Using weighted maximum likelihood estimators (proposed by Warm, 1989) could possibly be an appropriate solution, as this procedure provides one ability estimates for each total score on the test (Wu, 2005) and supposedly corrects biases usually generated by maximum likelihood estimators in logistic random-intercept models or item response models (Skrondal; Rabe-Hesketh, 2009). Nonetheless, this indicator of student achievement was not available in PIRLS 2006 database. Another alternative was modeling compositional effects at the individual level (following Lüdtke *et al*., 2008; Raudenbush; Bryk, 2002). This was done here by including SES (parents' highest educational level) within classes and centering it on its grand mean.

Only two predictors with statistically meaningful influence on (mean) achievement were found. *Reading self-concept* has a strong significant effect (b=-30.99) going beyond its effect on the student level whereas the *index*

of home-school involvement showed a marginal significant positive effect on achievement (b=4.69). No other hypothesized effect was found in the data (see Table 6 below). Thus, hypothesis 2, predicting teacher strategies to be positively associated with reading achievement, could not be supported.

Table 6 - *Intercepts- and slopes-as-outcome model*

	b	se	*t Ratio*	*p*	Δ
Intercept	603.58	9.01	66.98	.000	
Individual Level					
SES*	-9.97	1.20	-8.30	.000	
Books at home	-6.77	1.20	-5.65	.000	
Students' Parents Born in Country	-13.03	1.88	-6.93	.000	
Index of Students' Reading Self-Concept (SRSC)	-21.66	2.27	-9.53	.000	
How Well Students Could Perform Beginning Literacy Activities When They Entered School (HAIB)	-3.35	1.07	-3.13	.003	
Students Reading for Information Outside of School (INFR)	5.52	1.62	3.42	.003	
Index of Students' Attitudes Toward Reading (SATR)	-13.95	2.46	-5.66	.000	
Index of Student Safety in School (SSS)	-13.37	2.80	-4.78	.000	
Class Level					
Index of Students' Reading Self-Concept (classmean)	-30.99	13.84	-2.24	.027	-.24
Index of Home-School Involvement (HSI)	4.69	2.62	1.80	.073	.17

* Parents' highest education level: centered at its grand mean.

In order to assess the impact of the two significant class level indices, a recently proposed effect size for multilevel models (Tymms, 2004) was taken into consideration. This effect size for continuous level 2 variables can be interpreted similar to Cohens *d* and is calculated as follows:

$$\Delta = \frac{2\beta_1 * SD_{predictor}}{\sigma_e}$$

With this equation, delta effect size is provided by the unstandardized regression coefficient β_1, the standard deviation of the level-2 predictor variable (SD), and the level-1 residual standard deviation σ_e. As can be seen from Table 6, a small but meaningful effect emanates from both predictor variables putting the rather large slope coefficient from reading self-concept into perspective. Nevertheless, this effect should not be neglected. It shows evidence of a compositional effect which is still present after controlling contextual variables, attitudes and initial conditions (HAIB) of the students.

In a last step, potential cross-level interaction effects were modeled between attitudes and teacher strategies testing hypothesis 3. As described before, powerful compositional effects from SES on achievement as well on slope pa-

rameter of attitudes towards reading have been found. This context variable was taken into consideration as a main effect on individual level and was not further analyzed. Using the final intercepts- and slopes-as-outcome model as a starting point, cross-level interaction terms have been implemented between the *Index of and students' reading attitudes* (SATR), *Quality of instruction* (GRAO4 and GRAO6), *Index of Availability of School Resources* (ASR), *Index of Home-School Involvement* (HSI) and the aggregated *Index of Students' Reading Self-Concept* (SRSC). Results indicate no interaction effect. Therefore, hypothesis 3 was not supported.

Summary and Discussion

In this paper, associations between students' attitudes towards reading, teacher strategies and students' reading achievement were analyzed as factors of Walberg's education productivity model (REYNOLDS; WALBERG, 1992; WALBERG, 1981, 1986). To avoid overestimation of standard errors and a consequent underestimation potential statistical significance of level-2 factors, a multilevel approach was applied, as indicated by current state-of-art in quantitative research in Education (BLATCHFORD *et al*., 2002, 2008; GOLDSTEIN; BLATCHFORD, 1998; LEE, 2000; RAUDENBUSH; BRYK, 2002; SNIJDERS; BOSKER, 1999; SOARES, 2005).

Findings demonstrate that associations are highly complex. It seems that for researchers as well as practitioners it is hard or even impossible to identify a small specific set of variables that fully explains students' reading achievement. Thus, trying to improve students' reading abilities is a complex and demanding undertaking for two reasons. First, there are a lot of factors that have to be tackled simultaneously. Second, strategies that teachers use in the classroom, which seems to be one of the most tangible and changeable factors, fell short of our expectations as a predictor of reading achievement.

However, efforts of improving reading achievement should be made because being able to read is essential in order to function in modern society. Particularly, those efforts should be made at an early age, as every child reading ability is crucial in order to learn how to learn, shaping competences and abilities that will be relevant for adult success. Hence there should be always scope for policy efforts aimed at making children learn how to read and motivated to keep reading.

REFERENCES

ALLISON, P. D. **Missing Data**. Thousand Oaks, California (USA): Sage, 2001.

BLATCHFORD, P. *et al.* A study of class size effects in English school reception year classes. **British Educational Research Journal**, v. 28, n. 2, p. 169–185, 2002.

BLATCHFORD, P. *et al.* **Classes, groups and transitions: structures for teaching and learning**: Primary Review Research Surveys. Cambridge (UK): University of Cambridge, Faculty of Education, 2008. Disponível em: <http://hdl.handle.net/2428/26653>.

BROOKE, N. The GERES Project: a longitudinal study of the 2005 school generation in Brazil. **Revista Electrónica Iberoamericana sobre Calidad, Eficacia y Cambio en Educación**, v. 3, n. 1, p. 194–199, 2005.

CARROLL, J. A model of school learning. **The Teachers College Record**, v. 64, n. 8, p. 723–723, 1963.

COBB, C. W.; DOUGLAS, P. H. A theory of production. **The American Economic Review**, v. 18, n. 1, p. 139–165, 1928.

CONNOR, C. M. . *et al.* Instruction, student engagement, and reading skill growth in Reading First classrooms. **The Elementary School Journal**, v. 109, n. 3, p. 221–250, 2009.

ELLIOTT, E. S.; DWECK, C. S. Goals: An approach to motivation and achievement. **Journal of personality and social psychology**, v. 54, n. 1, p. 5, 1988.

FRASER, B. J.. *et al.* Synthesis of educational productivity research. **International Journal of Educational Research**, v. 11, n. 2, p. 147-252, 1987.

FOY, P.; KENNEDY, A. M. **PIRLS 2006 user guide - Supplement 1**. Chestnut Hill: International Association for the Evaluation of Educational Achievement (IEA), 2008.

FOY, P.; KENNEDY, A. M. **PIRLS 2006 user guide - Supplement 3**. Chestnut Hill: International Association for the Evaluation of Educational Achievement (IEA), 2008.

GELMAN, A. *et al.* **Bayesian data analysis**. 1st. ed. New York: Chapman & Hall, 1995.

GELMAN, A.; HILL, J. **Data analysis using regression and multilevel/hierarchical models**. New York: Cambridge University Press, 2007.

GETTINGER, M. Time allocated and time spent relative to time needed for learning as determinants of achievement. **Journal of Educational Psychology**, v. 77, n. 1, p. 3, 1985.

GNALDI, M. *et al.* Attitude items and low ability students: The need for a cautious approach to interpretation. **Educational Studies**, v. 31, n. 2, p. 103–113, 2005.

GOLDSTEIN, H. **Multilevel statistical models**. 4ª. ed. Londres (UK): Wiley, 2011. v. 847

GOLDSTEIN, H.; BLATCHFORD, P. Class Size and Educational Achievement: a review of methodology with particular reference to study design [1]. **British Educational Research Journal**, v. 24, n. 3, p. 255–268, 1998.

HANUSHEK, E.; RIVKIN, S. G.. The distribution of teacher quality and implications for policy. Annual Review of Economics, v. 4, p. 131-157, 2012.

KEITH, T. Z.; COOL, V. A. Testing models of school learning: Effects of quality of instruction, motivation, academic coursework, and homework on academic achievement. **School Psychology Quarterly**, v. 7, n. 3, p. 207, 1992.

KLUSMANN, U. *et al.* Teachers' occupational well-being and quality of instruction: The important role of self-regulatory patterns. **Journal of educational psychology**, v. 100, n. 3, p. 702, 2008.

KORNELL, N.; METCALFE, J. Study efficacy and the region of proximal learning framework. **Journal of Experimental Psychology: Learning, Memory, and Cognition**, v. 32, n. 3, p. 609, 2006.

KUKLA-ACEVEDO, S. Do teacher characteristics matter? New results on the effects of teacher preparation on student achievement. **Economics of Education Review**, v. 28, n. 1, p. 49–57, 2009.

KUSH, J. C.; WATKINS, M. W.; BROOKHART, S. M. The temporal-interactive influence of reading achievement and reading attitude. **Educational Research and Evaluation**, v. 11, n. 1, p. 29–44, 2005.

LAZARUS, B. D.; CALLAHAN, T. Attitudes toward reading expressed by elementary school students diagnosed with learning disabilities. **Reading Psychology**, v. 21, n. 4, p. 271–282, 2000.

LEE, V. E. Using hierarchical linear modeling to study social contexts: The case of school effects. **Educational Psychologist**, v. 35, n. 2, p. 125–141, 2000.

LITTLE, R. J. .; RUBIN, D. B. **Statistical analysis with missing data**. [S.l.] Wiley New York, 1987. v. 4

LÜDTKE, O. *et al*. The multilevel latent covariate model: A new, more reliable approach to group-level effects in contextual studies. **Psychological Methods**, v. 13, n. 3, p. 203, 2008.

LYON, M. A.; GETTINGER, M. Differences in student performance on knowledge, comprehension, and application tasks: Implications for school learning. **Journal of educational psychology**, v. 77, n. 1, p. 12, 1985.

MARTIN, M. O. *et al*. **PIRLS 2006 international report: IEA's progress in international reading literacy study in primary schools in 40 countries**. Chestnut Hill, Massachussets (USA): International Study Center, Lynch School of Education, Boston College, 2007.

MARTÍNEZ, R. S.; ARICAK, O. T.; JEWELL, J. Influence of reading attitude on reading achievement: A test of the temporal-interaction model. **Psychology in the Schools**, v. 45, n. 10, p. 1010–1023, 2008.

MULLIS, I. V. . *et al*. **PIRLS 2001 international report: IEA's study of reading literacy achievement in primary scools in 35 countries**. Chestnut Hill, Massachussets (USA): International Study Center, Lynch School of Education, Boston College, 2003.

NASCIMENTO, P. A. M. M. Fatores associados ao desempenho escolar: resultados de um modelo multinível de valor adicionado. **Estudos em Avaliação Educacional**, v. 51, p. 16–39, abr. 2012.

PALARDY, G. J.; RUMBERGER, R. W. Teacher effectiveness in first grade: The importance of background qualifications, attitudes, and instructional practices for student learning. **Educational Evaluation and Policy Analysis**, v. 30, n. 2, p. 111–140, 2008.

RAUDENBUSH, S. W.; BRYK, A. S. **Hierarchical linear models: Applications and data analysis methods**. [S.l.] Sage Publications, Inc, 2002. v. 1

REYNOLDS, A. J.; WALBERG, H. J. A process model of mathematics achievement and attitude. **Journal for Research in Mathematics Education**, p. 306–328, 1992.

RUSS, K. M. Relating Reading Attitude to Reading Achievement in an East Los Angeles Junior High School. **Reading Improvement**, v. 26, n. 3, p. 208–14, 1989.

SAINSBURY, M.; SCHAGEN, I. Attitudes to reading at ages nine and eleven. **Journal of Research in Reading**, v. 27, n. 4, p. 373–386, 2004.

SCHAFER, J. L. **Analysis of incomplete multivariate data**. Londres (UK): Chapman & Hall/CRC, 1997. v. 72

SKRONDAL, A.; RABE-HESKETH, S. Prediction in multilevel generalized linear models. **Journal of the Royal Statistical Society: Series A (Statistics in Society)**, v. 172, n. 3, p. 659–687, 2009.

SNIJDERS, T. A. B.; BOSKER, R. J. **Multilevel analysis: an introduction to basic and advanced multilevel modeling**. London: Sage Publications, 1999.

SOARES, T. M. Modelo de três níveis hierárquicos para a proficiência dos alunos de 4a série avaliados no teste de língua portuguesa do SIMAVE/PROEB-2002. **Revista Brasileira de Educação**, v. 29, p. 73–87, 2005.

STEELE, F.; VIGNOLES, A.; JENKINS, A. The effect of school resources on pupil attainment: a multilevel simultaneous equation modelling approach. **Journal of the Royal Statistical Society: Series A (Statistics in Society)**, v. 170, n. 3, p. 801–824, 2007.

SWALANDER, L.; TAUBE, K. Influences of family based prerequisites, reading attitude, and self-regulation on reading ability. **Contemporary Educational Psychology**, v. 32, n. 2, p. 206–230, 2007.

TYMMS, P. Effect sizes in multilevel models. *In*: SCHAGEN, I.; ELLIOT, K. (Eds.). **But what does it mean? The use of effect sizes in educational research**. Londres (UK): National Foundation of Educational Research, 2004. p. 55–66.

WALBERG, H. J. A psychological theory of educational productivity. *In*: FARLEY, F. H.; GORDON, N. (Eds.). **Psychology and education**. Chicago, Ohio (USA): National Society for the Study of Education, 1981. p. 81–110.

WALBERG, H. J. Synthesis of research on teaching. *In*: WITTROCK, M. C. (Ed.). **Handbook of research on teaching**. Nova Iorque (USA): MacMillan, 1986. p. 214–229.

WALBERG, H. J.; TSAI, S. L. Correlates of reading achievement and attitude: A national assessment study. **The Journal of Educational Research**, v. 78, n. 3, p. 159–167, fev. 1985.

WARM, T. A. Weighted likelihood estimation of ability in item response theory. **Psychometrika**, v. 54, n. 3, p. 427–450, 1989.

WIGFIELD, A.; ASHER, S. R. Social and motivational influences on reading. *In*: PEARSON, P. D. *et al.* (Eds.). **Handbook of reading research**. Nova Iorque (USA): Longman, 1984. p. 423–452.

WILEY, D. E.; HARNISCHFEGER, A. Explosion of a myth: Quantity of schooling and exposure to instruction, major educational vehicles. **Educational Researcher**, v. 3, n. 4, p. 7–12, 1974.

WITKOW, M. R.; FULIGNI, A. J. Achievement goals and daily school experiences among adolescents with Asian, Latino, and European American backgrounds. **Journal of educational psychology**, v. 99, n. 3, p. 584, 2007.

WOOLDRIDGE, J. M. **Introductory econometrics: a modern approach**. 4ª. ed. Mason, Ohio (USa): South-Western, 2009.

WORRELL, F. C.; ROTH, D. A.; GABELKO, N. H. Elementary reading attitude survey (ERAS) scores in academically talented students. **Roeper Review**, v. 29, n. 2, p. 119–124, 2006.

WU, M. The role of plausible values in large-scale surveys. **Studies in Educational Evaluation**, v. 31, n. 2-3, p. 114–128, 2005.