

# **The importance of class composition for reading achievement: Migration background, social composition, and instructional practices**

## **An analysis of the German 2006 PIRLS data**

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In this article, we explore the effects of class composition and teachers' instructional practices on reading achievement in German primary schools. We used data from the German data set for PIRLS 2006 to consider effects of class composition in terms of social and linguistic characteristics. Our analysis also focused on process characteristics of instruction, notably whether teacher instruction, when modified to meet the needs of individual students, alleviated the effects of a disadvantageous class composition. Our particular aim with respect to this study was to examine the processes by which these effects may be transmitted. The results of our multilevel analyses indicated the importance of individual resources and also the effects of class composition variables in terms of language and educational resources on students' reading achievement. We found that the effect of the variety of organizational approaches a teacher was using did not relate to reading achievement and did not reduce the effects of a disadvantageous class composition. However, classes with this composition showed a higher variance in their students' achievement scores. Also, teachers in these classes were already using a variety of instructional methods to accommodate the heterogeneous achievement levels. Controlling for the variety of methods might not be a sufficient means of explaining the transmission processes of class composition: teacher and student interactions at the micro level might also be important factors.

## INTRODUCTION

In Germany, in recent years, the generally poorer educational performance of students from immigrant families relative to students from nonimmigrant families has become an issue of increasing concern. This matter gained particular prominence with the release of the results of the Organisation for Economic Co-operation and Development's (OECD) first Programme for International Student Assessment (PISA) survey (see, for example, Baumert, Trautwein, & Artelt, 2003; Stanat & Christensen, 2006). This cross-national study of the educational achievement of 15-year-old students made obvious the particularly large performance differences in Germany between immigrant students and nonimmigrant students (Stanat & Christensen, 2006, p. 6). Different achievement patterns between students from these two groupings have also been evident for some time at the elementary level of the German schooling system (Bos, Lankes, & Prenzel, 2004). The iterations of the Progress in International Reading Literacy Study (PIRLS), which is conducted by the International Association for the Evaluation of Educational Achievement (IEA) and surveys children in the fourth grade (nine-year-olds), present a similar picture. In short, studies of educational achievement over the last decade suggest that the German education system has not been able to meet the demands of its changing student population.

Efforts to explain the processes governing the structural integration of immigrants and the educational success of students from immigrant families in Germany focus on different factors (Esser, 2006; Kalter, 2008). Family and individual resources, such as social capital and competence in the German language, play an important role in educational achievement. School and classroom-based characteristics, such as the selectivity of the German education system,<sup>1</sup> also account for inequality in educational attainment (for an overview, see Stanat, 2006; also Esser, 2006).<sup>2</sup>

Among the weaker factors that are associated with ethnic inequality is the social composition of the school or the class a student attends. Research on the effects of class or school composition on achievement and on how these effects are transmitted is still scarce. However, the evidence that is available indicates that class or school composition characteristics do not directly influence achievement but are mediated by peer-based influences or instructional characteristics (Dreeben & Barr, 1988; Hattie, 2002; Wilkinson, 2002). Analyzing the composition of the student body is useful not only because it allows us to add to this body of literature but also, and more importantly, because it gives us a broader perspective on the social conditions and contexts within which educational processes take place, or, to express this statement another way, on the *mechanics* of educational inequality.

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1 Unlike other European countries, German students leave primary school at the age of 10 and are tracked into different types of secondary school. This tracked system tends to be highly socially selective. The track that a child enters after primary school determines in large part his or her future educational career.

2 For an account of the German education system, see Baumert, Stanat, and Watermann (2006) and Ditton and Krüsken (2006).

The German PIRLS data provided an opportunity to examine the reading achievement of students with immigrant backgrounds in relation to the composition characteristics of the student body and instructional process variables. Our focus was on the elementary level because it is here that achievement differences have a far-reaching impact on decisions regarding German students' subsequent educational trajectories and long-term educational success (Becker & Lauterbach, 2004). More specifically, we address the issue of class composition in relation to instructional processes that aim to mediate heterogeneity and thereby reduce achievement gaps between students from different social and ethnic backgrounds. Using a theoretical framework, we begin by describing how differences in achievement between immigrant and nonimmigrant students emerge and how composition effects exert an influence. We then, in the empirical part of our examination, include, in a multilevel model analysis, the variables that researchers conducting analysis of composition effects considered and then reported with respect to the German PIRLS 2006 data. We end the article with a discussion of our main findings.

## **ACHIEVEMENT DIFFERENCES IN THE ELEMENTARY SCHOOL SECTOR: THEORETICAL APPROACHES AND EMPIRICAL EVIDENCE**

Differences in educational attainment can be attributed to the primary effects of family background characteristics as well as to the secondary effects arising out of the decisions that families make when selecting educational opportunities for their children. These decisions are based on the expected costs and benefits of those opportunities and the likelihood of achieving a chosen goal (Becker & Lauterbach, 2004; Boudon, 1974; Erikson & Jonsson, 1996). Because students from immigrant families tend to have less social and economic capital than students from nonimmigrant families, primary effects tend to be more pronounced. For example, the members of immigrant families in Germany are nine times more likely than the members of non-immigrant families to have received no formal education and they are more than twice as likely to be on welfare support (Statistisches Bundesamt, 2009, p. 29). Also, these families may not be able to use the social and educational capital that they acquired in their countries of origin because of language difficulties, non-acceptance of qualifications, or poor knowledge of education systems in general or the German education system in particular (Diefenbach, 2007, p. 101).

Another important factor governing educational integration, and therefore educational attainment, that has gained increasing attention in the educational literature in recent years is immigrants' knowledge of their new country. The extent of this knowledge depends on opportunities that these people have both before and after immigration to acquire that knowledge. For example, children of immigrant families will likely be impeded from acquiring the language of the immigrant country if they live in a situation where the language of that country is seldom spoken or not spoken at all (Esser, 2006, p. 9).

Whether from immigrant or nonimmigrant families, students with few economic and social resources are disadvantaged from the time they enter elementary school. Any conceptual model of how school processes affect the achievement of students thus needs to consider the clusters of variables associated with different aspects of the education system. The various recent and current theoretical models that aim to explain differences in student learning tend to consider variables associated with either one or more perspectives or “levels” of the education system.

Models of educational effectiveness based on Carroll’s (1963) model of time on task consider student learning in terms of student-related variables. These models position learning effectiveness as a function of aptitude, ability to understand instruction, perseverance, opportunity, and the quality of instruction (see, for example, Creemers, Scheerens, & Reynolds, 2000, p. 283).

Creemers (1994), in his model, distinguishes basic student-related variables as well as variables associated with the classroom and with the school. Among the variables at the classroom level that contribute to educational effectiveness are the types of learning resources (books, computers) available, the way the teacher delivers learning content and manages the learning environment (e.g., clear goal setting, provision of homework), and the procedures and practices the teacher uses to group students so that they receive instruction commensurate with their learning needs and abilities. Variables at the school level include the number of daily hours of instruction and the overall quality of teaching across the school (Creemers, 1994, p. 98).

School-level variables also include those that are context specific. Consideration of these variables began appearing in the literature in the 1980s. The variable that gained the most initial attention was the socioeconomic composition of the student body (for an overview, see Teddlie, Stringfield, & Reynolds, 2000, p. 161). Consideration of the ethnic, social, and abilities composition of the school—and individual classes within a school—followed (see, for example, Portes & Hao, 2004; Portes & MacLeod, 1996).

Researchers are also now paying attention to how these various composition characteristics are mediated by the social interaction between students and their teachers. In their conceptual model of influences on student learning achievement and academic self-concept, Baumert et al. (2006, p. 126) identified five composition characteristics—social, cultural, ability, “at-risk” factors (relating to family situation and school-career choice), and the context-specific effects of different curricula—along with four presumed mediation processes. These mediation processes are the normative culture of the student’s parents, the normative culture of students, social comparison processes at the student level (i.e., abilities, attitudes, and achievement of peers), and how instruction is organized and delivered.

The processes by which composition effects are transmitted can be categorized under sociological and psychological explanations and according to approaches that focus primarily on instructional processes (Dar & Resh, 1994; Dreeben & Barr, 1988; Hallinan, 1988; Marsh & Hattie, 1996; Pallas, Entwisle, Alexander, & Slutka, 1994). A focus on instructional processes assumes that the composition of the class, or even

the perception that the teacher has of the composition of the class, affects instruction-based characteristics such as pace and level of instruction and teacher expectations (Dreeben & Barr, 1988; Oakes, 2005).

As we noted at the beginning of this article, empirical evidence suggests that, especially in the case of Germany, students from immigrant families fare worse educationally than children from nonimmigrant families (Baumert et al., 2003; Bos, Schwippert, & Stubbe, 2007). Although much of this difference in achievement can be explained by considering the socioeconomic resources of the two groups, a significant difference in achievement remains. This gap appears to be a product of specific effects connected to the specific migration context, for example, language use (Heath & Brinbaum, 2007). Research shows that language used at home and proficiency in the language used at school are important factors explaining the achievement difference (e.g., Alba, Handl, & Müller, 1994; Esser, 2006). However, during the last few years, educational researchers have also taken into greater account composition characteristics, positioning them as distal factors that may influence achievement.

### **Composition Characteristics**

Does the school a child attends influence his or her educational achievement? Without necessarily having any scientific evidence to support their viewpoint, parents tend to think that it indeed matters who is teaching the child and with whom he or she is learning. Even in Germany, where public schools have long been the natural choice for everyone, the enrollment numbers in private schools increased by approximately 21% in the first eight years of this century (Statistisches Bundesamt, 2008). The demographic composition of the student body of a school or a class purported to influence achievement differences is known as the “compositional” effect: “Such an effect is often reported when a school-level aggregate of an individual variable makes an independent contribution to the explanation of outcome variance” (Harker & Tymms, 2004, p. 177). This premise implies that any two students who have similar reading scores but are from different schools or classes will differ in their predicted scores because of the composition characteristics of the school or class they attend.<sup>3</sup>

The influence of composition variables on achievement was signaled as early as the 1960s by Coleman (1966). His results showed that composition characteristics in terms of the social structure of a school seemed to be more important than the school’s resources or the quality of teaching (1966). Since then, several studies have verified the influences of school and class composition on achievement (e.g., Ammermüller & Pischke, 2006; Opdenakker & Van Damme, 2001; Rumberger & Palardy, 2005). Thus, in addition to variables associated with individual characteristics and family background resources, achievement can be influenced by the mix of social

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<sup>3</sup> In addition to composition effects, there can also be context effects. The term contextual effect is mainly used to describe effects that include differences between school systems (private or public), class size, or grade levels (Teddlie et al., 2000, p. 162). This article is concerned with the effects of student composition as a function of the aggregated individual variable at the school or the class level.

backgrounds represented in the class or the school (e.g., socioeconomic status, percentage of non-native speakers) or students' abilities (e.g., Burns & Mason, 2002; Caldas & Bankston, 1998; Harker & Tymms, 2004).

Through use of a multilevel model, Walter (2008) examined the assumed negative effect of the ethnic composition of the class on students' mathematics, science, and reading achievement with the aim of determining whether this effect was transmitted by the ethno-lingual diversity of the class. After controlling for the different school types in the secondary school system in Germany, Walter found that the social composition of the class had a significant effect on reading achievement only. However, mathematics achievement was significantly affected by the percentage of immigrant students in the class. Compared to classes where less than 5% of the students were from immigrant backgrounds, classes with more than 70% of such students were achieving one year below the normative standard in mathematics. Walter could not trace this effect back to difficulties associated with German as the language of instruction because he found that the language students used at home had no effect on achievement (p. 178). The PISA data for Germany confirmed this pattern, albeit in relation to reading achievement. The data showed that the reading achievement of students in schools with more than 40% of students of Turkish descent was significantly lower than the reading achievement of students in schools where only 5% of the children were from Turkish families. Again, the composition variable of language use at home had no significant effect on achievement (Walter & Stanat, 2008, p. 94).

Composition effects are also discernible in elementary schools in both Germany and internationally (e.g., Cortina, Carlisle, & Zeng, 2008; Ruesch, 1998; Sharp & Croxford, 2003), although the body of evidence is not as large as that for the secondary sector. Cortina et al. (2008), for example, analyzed students' progress from Year 1 to Year 3 in the Michigan Reading First program. They found that the reading gain for students from schools with a high percentage of students deemed economically disadvantaged was 10% lower than the gain for students in schools with a relatively low percentage of economically disadvantaged students. School composition thus had an effect on students' reading achievement additional to the individual effect of few economic resources. Also, but to a lesser extent, learning progress was slower in schools with a high percentage of minority students than it was in schools with a low percentage (Cortina et al., 2008, p. 60). The authors acknowledged not only a lack of data on whether at-risk students receive instruction in reading that is appropriate for their needs (e.g., adaptive teaching methods) but also a need for a closer examination of instructional practices (p. 63).

In Germany, Kristen (2008) used data from the German national extension of PIRLS called *Internationale Grundschul-Lese-Untersuchung* or IGLU-E, which covered reading achievement and mathematics and science, to examine different characteristics assumed to influence ethnic-based inequalities in educational achievement. Kristen's focus was on immigrant students of Turkish descent. Her results showed that, at the level of the individual, students' reading achievement scores depended on whether one or both parents were born in Germany and on the social and cultural resources of the families. Furthermore, if spoken at home, German language had a positive effect

on scores. Parental place of birth, social and cultural resources, and German language spoken at home also influenced mathematics achievement. However, Kristen found that the different social and language resources of the students' families did not fully explain the achievement deficit for the Turkish students. At the class level, the mean ability composition of the class influenced reading and mathematical achievement, but did not reduce the negative effects on reading achievement for students from Turkish immigrant families. The language composition of the class did not exert an influence (p. 246). Kristen's findings correspond with those from Walter (2008) and Walter and Stanat (2008).

Overall, research on composition effects is ambiguous in that it is not clear which composition effects influence achievement. Many of the researchers who have published studies associated with this issue do not consider all relevant composition characteristics and do not make clear whether certain composition characteristics are greater for some students than for others (Rumberger & Palardy, 2005, p. 2006). Also, uncertainty remains as to how composition effects on achievement are transmitted. The assumption is that, at the least, they exercise an indirect effect. The literature proposes three possible types of mediation (e.g., Dar & Resh, 1994; Dreeben & Barr, 1988). Explanations focused on the process characteristics of teaching assume a better or worse learning climate and motivated or unmotivated teachers. Sociological approaches consider peer effects as an important factor with respect to generating a positive or a negative learning climate. Psychological explanations argue that teachers may have unreasonably low or high expectations of student achievement in classes with a particular (e.g., homogeneous or heterogeneous) student population. Hanushek, Kain, Markman, & Rivkin (2003), for example, conclude from their consideration of peer influence that

In general there has been limited attention given to the mechanisms through which peers affect outcomes. The most common perspective is that peers, like families, are sources of motivation, aspiration and direct interactions in learning. Moreover, peers may affect the classroom process—aiding learning[,] ... contributing to the pace of instruction, or hindering learning through disruptive behaviour. (p. 529)

One possible reason for this lack of clarity is the complexity of composition effects and their interactions with so-called school process variables (e.g., class climate or teacher expectancies). This complexity is evident in work done by Opdenakker and Van Damme (2001). They studied the effects on students' mathematics achievement of mean socioeconomic status and mean cognitive capacities, heterogeneity of intellectual capacities, gender composition, and percentage of students using the language spoken at school and at home, as well as the relationships of these variables to several process variables (among them, co-operation between teachers and differences between students). Rumberger and Palardy (2005) grouped schools into three categories based on the prosperity of enrolled students. Having found that these socioeconomic differences influenced student achievement, they went on to explain this effect statistically by considering diverse variables, such as amount of homework and students' perceptions of safety at school.

With respect to the above review, what can be said in summary is that a variety of factors pertaining to the individual, the class, the school, and context (e.g., neighborhood characteristics) influence learning achievement (Helmke et al., 2007, p. 18). For students from immigrant families, educational inequalities also derive not only from the likelihood that these students have fewer economic, social, and cultural resources than students from nonimmigrant backgrounds but also from a disadvantageous composition of the class caused by the composition of the school district. For the individual student, parents' level of educational attainment and their occupation as well as whether the language used at home accords with the language of instruction at school also influence achievement.

At the class level, researchers have examined a variety of composition effects. In the German elementary system, these include the social, ethnic, and linguistic composition of the class. It seems that, here, linguistic composition does not have an effect on achievement and that composition effects do not seem to be transmitted by the opportunities available to use the German language. Overall, though, there is little research on just how these and other composition effects are transmitted. Nonetheless, we can assume that teachers adapt their instruction according to their perception of the ability composition of the class. For example, in classes with a high percentage of at-risk students, teachers may barely use differentiation or adaptive instruction, such as grouping procedures to offer different content, because of the assumed homogeneity of the class. Based on the results of a comprehensive meta-analysis, Hattie (2003) concluded that about 30% of students' achievement variance can be traced back to teacher characteristics. Consideration of instructional variables as well as of composition characteristics therefore seems important.

Although a class may show homogeneity in terms of its social composition, students will still differ in their individual learning capacities. Data for Germany from the 2001 and 2006 iterations of PIRLS (Bos et al., 2004, 2008) showed that instruction in a classroom is, most of the time, teacher oriented and does not take into account the heterogeneity of knowledge held by the individual students in that class. The approaches that teachers do use to meet perceived different achievement levels in class typically involve differentiating learning content and adapting the organizational setting of the classroom: "Adaptive teaching is teaching that arranges environmental conditions to fit learners' individual differences" (Corno & Snow, 1986, p. 621). Any analysis of composition effects should thus also consider the various organizational approaches that teachers use to differentiate their instruction according to student need. It seems reasonable to assume that instruction that is learner oriented is more likely to enhance student learning than instruction that does not take this focus.

## STUDY OBJECTIVE AND APPROACH

Our focus when conducting this study rested on a conceptual framework of schooling based on a model of educational effectiveness (Creemers, 1994) and a mediation model of composition characteristics (Baumert et al., 2006). The conceptual model therefore accounted for the input (e.g., student resources), the output (e.g., student achievement in reading), and the various other aspects of the educational process (e.g., teacher characteristics) underpinning the theoretical model of PIRLS (Hornberg, Bos, Buddeberg, Potthoff, & Stubbe, 2007a, p. 22). In an attempt to explain differences in reading achievement between immigrant students and nonimmigrant students, we concentrated our analysis on those aspects of educational inequality that lie beyond the individual level (i.e., composition effects). We also considered the quality of the teacher's instruction within the class. Our aim, in this regard, was to determine whether differentiated learning environments (grouping procedures) may reduce achievement differences.

Although it is obvious that classroom processes rely on complex interactions among many influences—all of which have to be considered—we concentrated on those aspects shown to be relevant in explaining ethnic differences in achievement. We concentrated at the individual level on characteristics of immigration background. One such characteristic is the country in which students' parents were born (research often conceptualizes immigration background in terms of this variable). We also considered the language used at home. To control for the variable of socioeconomic status, we used the variable home educational resources.

At the class level, we considered the influence of class composition in terms of linguistic background, educational resources, and mean reading achievement on the reading accomplishment of 10-year-old students in Grade 4 of the German elementary school system. We also considered, as a process characteristic, a variety of organizational approaches used by teachers.

Our specific research questions were as follows:

1. What proportion of the variance in student reading achievement can be attributed to (i) individual student background characteristics and (ii) the class level?
2. To what extent do specified class composition characteristics influence students' reading achievement?
3. To what extent do teacher instructional characteristics on their own influence students' reading achievement and to what extent do these characteristics have an effect on reducing achievement differences at the level of the individual and at the level of the class?

## METHOD

### Data and Variables

The reading achievement data that we used for this study came from the German PIRLS 2006 data. The PIRLS iterations use a two-stage process to select participating students. During the first stage, schools are sampled with probability proportional to size. During the second, one or two intact classes of students are sampled. Systematic random sampling is used to select the classes; all classes have an equal probability of being selected (Joncas, 2007). In Germany, during PIRLS 2006, one class per school was sampled, and all students within a sampled class participated (Martin, Mullis, & Kennedy, 2007, p. 241). Of the 8,032 students who were supposed to complete the reading test, 7,899 did so (Hornberg et al., 2007a, p. 39). To account for this cluster design, data analyses were conducted with the appropriate weights (house weight) and multilevel models were used to estimate the coefficients (Bryk & Raudenbush, 1992).

For our analysis, we drew from the German PIRLS 2006 data bank the reading achievement data of 5,464 (in 364 classes) of the participating students. We did not consider data from all 7,899 students who participated because we wanted to include only those students for whom data on all relevant variables were available.<sup>4</sup>

The reading test booklets used in PIRLS 2006 consisted of a literary text and an informational text. Each student received two texts, each with 25 test items (Bos, Valtin, Voss, Hornberg, & Lankes, 2007, p. 86). The tasks that students were asked to complete in relation to these texts tested their understanding and ability to reproduce content as well as comprehension tasks. The reading achievement scores represented five imputed plausible values. The reading achievement scale had 500 as the average and a standard deviation of 100 (Foy & Kennedy, 2008a, p. 5). For our analysis, we considered the overall reading score for the sample of students, and we considered all five plausible values during the estimation process.

In regard to the individual, we also considered *gender* in our model because previous research shows that boys are over-represented on the lower levels of reading competency (Hornberg, Valtin, Potthoff, Schwippert, & Schulz-Zander, 2007b, p. 207). Gender is a dichotomous variable and so has the value of 0 for girls and 1 for boys. In the analysis, we used girls to represent the reference category.

In PIRLS, the immigration background of the students is operationalized by using the variable language used at home. Students participating in the 2006 survey were asked, "How often do you speak the test language at home?" and were directed to check one of the following answers: 1 = always, 2 = sometimes, and 3 = never. Because only 55 of the 5,464 students in our sample reported that they never spoke the test language at home, we recoded this variable as a dichotomous variable by combining the categories "sometimes" and "never." Thus, sometimes and never = 1 and always = 0, thereby representing the reference category.

<sup>4</sup> Across the individual-level variables, the proportion of missing data ranged from 3% to 20%. At the class level, we had to exclude 40 classes from the analysis because of missing data on the variables for this level.

The country in which parents were born can also be considered an identifier of immigration background. The students participating in PIRLS were asked if their mother or father was born in Germany (1 = yes, 2 = no, 3 = I do not know).<sup>5</sup> The derived variable distinguishes among three categories: students whose parents were both born in Germany, students who had one parent who was born in Germany, and students whose parents were both born in another country. For the analysis, we coded this measure as a stepwise dichotomous variable so that students with both parents born in Germany represented the reference category.

Social and cultural resources are operationalized in PIRLS via the derived variable home educational resources.<sup>6</sup> This index variable consists of the following four items:

1. About how many books are there in your home? (0–10, 11–25, 26–100, 101–200, more than 200);
2. About how many children’s books are there in your home? (0–10, 11–25, 26–50, 51–100, more than 100);
3. Do you have any of these things in your home? (computer, study desk/table for own use, books of your very own, daily newspaper);
4. Highest level of education of either parent? (finished university or higher, finished post-secondary education but not university, finished upper-secondary, finished lower-secondary, finished some primary or lower-secondary or did not go to school).

The index variable distinguishes three categories:

- 1 = *high*: student responded “101–200” or “more than 200” to (1) and “yes” to three or more of the variables of (3); parents responded “finished university or higher” to (4) and “26–50”, “51–100”, or “more than 100” to (2);
- 3 = *low*: student responded “0–10” or “11–25” to (1) and “yes” to two or fewer of the variables of (3); parents responded “finished some primary or lower-secondary or did not go to school” to (4) and “0–10” or “11–25” to (2);
- 2 = *medium*: all other response combinations (Foy & Kennedy, 2008a).

For our analysis, we recoded this variable as a stepwise dichotomous variable so that students with high home educational resources represented the reference group.

At the class level, we considered composition as well as instructional characteristics in the model. We accordingly derived the percentage of students in the class who did not speak the test language before school by aggregating the number of students in relation to the class size to represent the class composition in terms of migration (i.e., linguistic characteristics).

5 Three percent of the students did not know where their mother was born, and about four percent did not know where their father was born. Ten percent of the data were missing.

6 This variable was featured in the questionnaire that asked the participating students to answer questions about their home lives and living conditions.

To account for the social composition of the class, we also calculated the percentage of students with low home educational resources. As a process feature accounting for instruction that is responsive to the different learning conditions of the students, we used the variable *teachers use a variety of organizational approaches*. This derived variable consists of six items relating to the question, “When you have reading instruction and/or do reading activities, how often do you organize students in the following ways?” (1 = always; 2 = often, 3 = sometimes; 4 = never):

- I teach reading as a whole-class activity;
- I create same-ability groups;
- I create mixed-ability groups;
- I use individualized instruction for reading;
- Students work independently on an assigned plan or goal;
- Students work independently on a goal they choose themselves.

The derived variable has two values: 1 = responded “often” or “always or almost always” to two or more of the options; 2 = responded “often” or “always or almost always” to one or none of the options (Foy & Kennedy, 2008b). We recoded this variable for the analysis into categories 2 = 0 and 1 = 1 so that teachers who used few differentiation techniques represented the reference category (= 0).

### ***Hierarchical Data Structure***

Students within schools and classes represent a hierarchical data structure because they are nested within their schools and classes. Students in the same classes tend to be similar in some aspects, due, for example, to selection processes. Therefore, the observations are not completely independent. Disregarding this fact leads to underestimation of the standard errors (Hox, 2002, p. 5). In PIRLS, hierarchical linear modeling (HLM) 6.2 (Raudenbush, Bryk, Cheong, & Congdon, 2004) is therefore used to conduct the data analysis. The Level 1 unit consists of the student variables, and the Level 2 unit represents the composition and instruction characteristics.

For our analysis, we estimated the relevant student variables for Level 1 and then included, as the next step, the corresponding class-level variable. A multilevel model such as this allows us to distinguish different types of group-level variables. The first group of variables (in our case, the use of different organizational approaches) can be measured directly. The second type is generated by aggregating variables from a lower level, that is, the student composition of the class (Stanat & Lüdtke, 2008, p. 326). This approach allowed us to interpret the coefficient of the class composition variable as the direct estimate of the composition effect on reading achievement above the effect of the individual characteristics.

Because of the reciprocal nature of composition effects (a student affects his or her peers and is affected by peers), it is very difficult to separate out causal impacts (Hanushek et al., 2003, p. 530). The most adequate form of analyzing composition effects requires a longitudinal data set (a fact that we considered when interpreting our results); a cross-sectional design does not allow postulation of causal relationships.

## Analysis

### ***Descriptive Information***

We list the descriptive statistics of the individual-level variables in Tables 1 and 2. The average reading achievement of all students in the sample reached 547, with a minimum of 244 and a maximum of 740 ( $SD = 67.55$ ). Just over 49% of the students were girls. With respect to migration background, 13% of the students had one parent who was not born in Germany; 15% of the students came from families where both parents were born in other countries. Accordingly, 28% of students never or only sometimes spoke the test language at home. Most of the students (84%) had medium educational home resources.

In nearly every class, a minority of students did not use the test language at home ( $M = 5.62$ ,  $SD = 8.59$ ). The class composition ranged from classes with all students speaking the test language at home to classes with 50% of students who did not speak the test language at home. In contrast, on average, one-fifth of the students in every class came from home backgrounds with few educational resources ( $M = 3.82$ ,  $SD = 7.33$ ). However, the sample included a broad range of class composition in this respect: there were classes in which 60% of the students came from homes with few educational resources, and there were classes in which no student was deprived in this respect. Teachers usually used a variety of organizational approaches ( $M = .33$ ,  $SD = .47$ ), ranging from one scale end (0) to the other (1).

When we analyzed reading achievement, home educational resources, and use of test language at home for the different groups of immigration background, we found that students with both parents born in Germany used the test language at home more often than students with neither parent was born in Germany, but this relationship was not a consistent one (see Table 2).

As a preliminary step, we analyzed the effects of relevant class-level variables on the mean reading achievement of students in every class. Here, we found a significant relationship between the percentage of students who did not speak the test language at home and the class mean reading achievement, thereby explaining 12% of the variance in mean class reading achievement (see Figure 1). As we expected, classes with a higher percentage of students who did not speak the test language at home had lower mean reading scores. However, there was a wide range in mean reading achievement among classes with a low percentage of students who did not speak the test language.

The class mean reading achievement and the percentage of students with few educational resources showed a strong relationship; this variable explained 28% of the variance (see Figure 2). Classes with a high percentage of students with few educational resources tended to have lower mean reading achievement scores. There were, however, some exceptions. Some classes in which most students had few educational resources scored reasonably high in reading, whereas some classes with a high percentage of well-resourced students showed relatively low mean reading achievement.

Table 1: Descriptive statistics

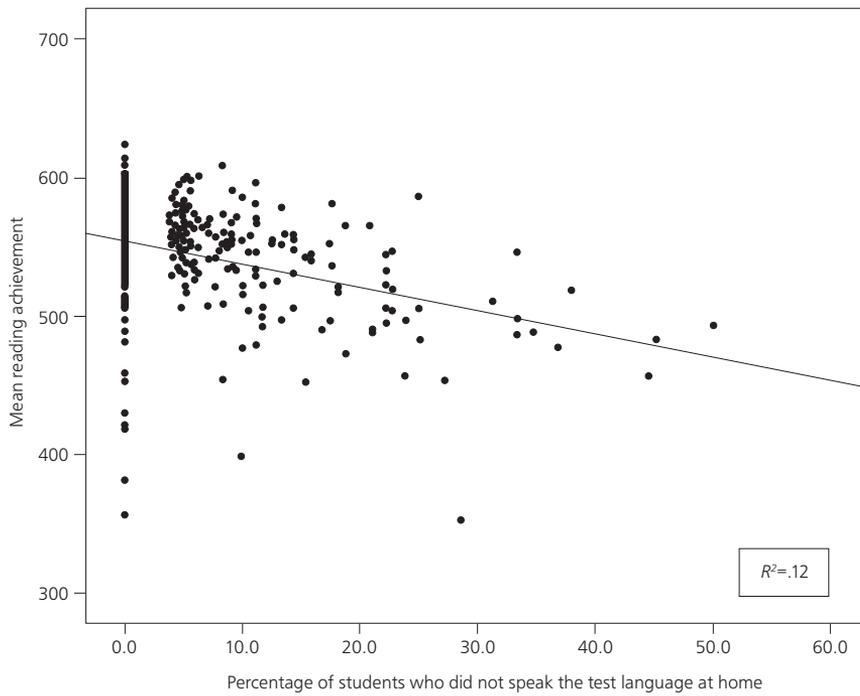
Individual level	
<i>Reading achievement</i>	
<i>M</i>	547.27
<i>SD</i>	67.55
Min	243.87
Max	739.68
<i>Gender</i>	
Boys	49.2%
Girls	50.8%
<i>Migration background</i>	
Both parents born in the country	72.0%
One parent born in the country	13.0%
Neither parent born in the country	15.0%
<i>Language of instruction used at home</i>	
Always	72.0%
Sometimes or never	28.0%
<i>Home educational resources</i>	
High	13.0%
Medium	84.0%
Low	3.0%
Class level	
<i>Percentage of students not speaking test language at home</i>	
<i>M</i>	5.62
<i>SD</i>	8.59
Min	0.00
Max	50.00
<i>Percentage of students with few educational resources</i>	
<i>M</i>	3.82
<i>SD</i>	7.33
Min	0.00
Max	60.00
<i>Teacher uses variety of organizational approaches</i>	
<i>M</i>	0.33
<i>SD</i>	0.47
Min	0.00
Max	1.00

In classes where the mean reading achievement was high, the variance of the achievement score was relatively small, and vice versa. Also, in classes where the percentage of students with low educational resources was high, the variance of the reading achievement increased. This finding implies that, especially in classes such as these, it is important that teachers use a variety of organizational approaches in order to accommodate the individual and different learning needs of their students.

Table 2: Descriptive information: language used at home and immigration background

	Both parents born in Germany	One parent born in Germany	Neither parent born in Germany
<i>Reading achievement</i>	564.67 (58.16)	542.25 (59.42)	515.84 (62.41)
<i>Home educational resources</i>			
High	15%	12%	3%
Medium	84%	86%	91%
Low	1%	2%	6%
<i>Use of test language at home</i>			
Always	87%	54%	18%
Sometimes or never	13%	46%	82%

Figure 1: Relationship between reading achievement and percentage of students who did not speak the test language at home



Surprisingly, the mean reading achievement did not seem to be linked to teachers’ use of a variety of organizational approaches to reading instruction (see Figure 3). However, classes with teachers who used more than two approaches showed a greater variety in mean reading achievement than classes with teachers who used fewer approaches. What this finding tells us is that teachers in classes with a higher variance in achievement scores tend to use more than two organizational approaches.

Figure 2: Relationship between mean reading achievement and percentage of students with low educational resources at home

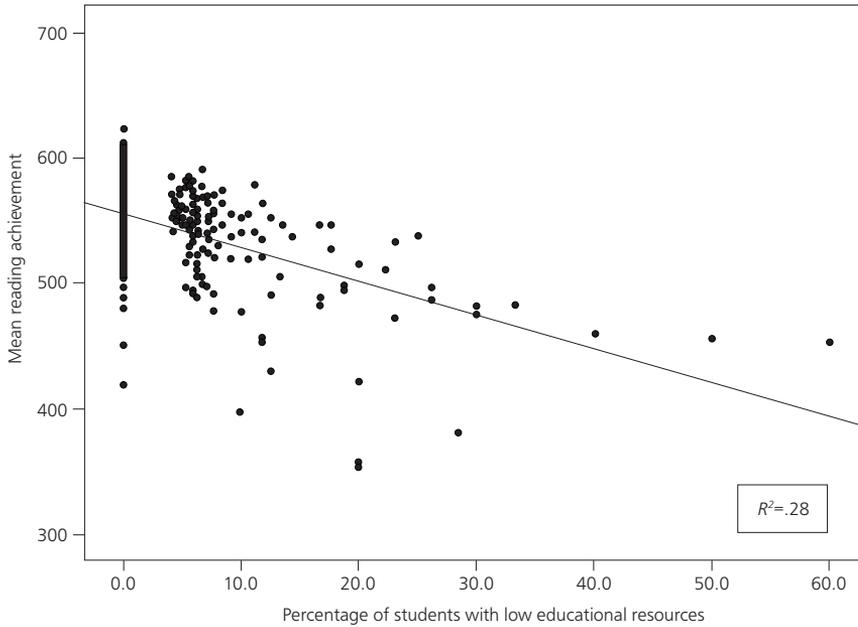
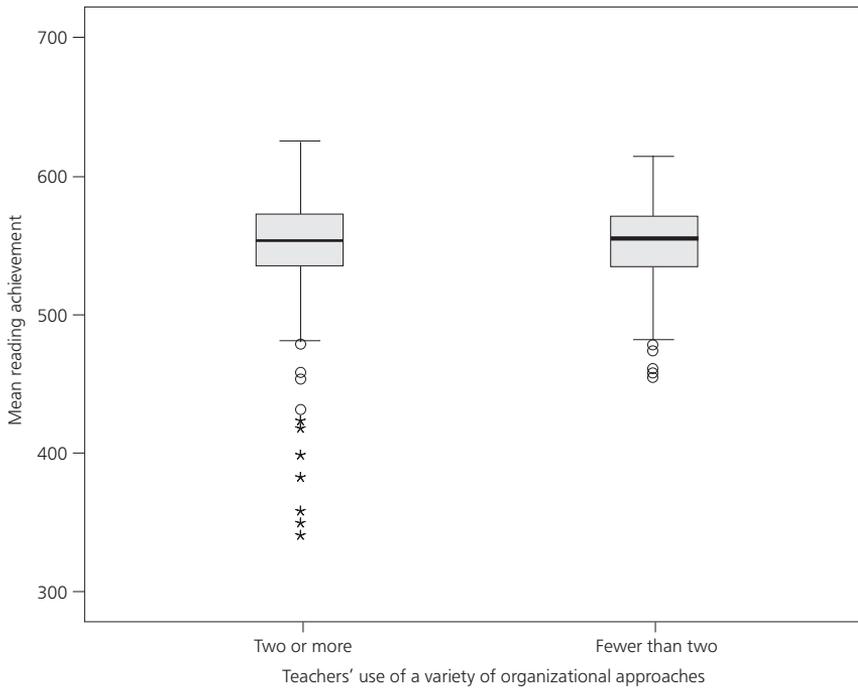


Figure 3: Boxplot of mean reading achievement and teachers' use of a variety of approaches to organize their classroom instruction



### ***The Multivariate Analysis***

Table 3 presents the findings of the multilevel analysis. Here, the baseline model represents the unconditional model. The following models include individual, composition, and process variables. In a multilevel model, the variance component of the two levels can be calculated by using the intra-class correlation, which gives an estimate of the proportion of variance that exists between the classes and can actually be explained by class-specific characteristics (Bryk & Raudenbush, 1992, p. 70). The inter-class correlation (ICC) for our data set was 21%, so the class that a student was attending apparently did make a difference. To put this another way, 21% of the variance was between the classes and could therefore be explained by class-level variables. This result is within the range of findings from other studies of student achievement (e.g., Ditton & Krüsken, 2006; Opdenakker, Van Damme, De Fraine, Van Landeghem, & Onghena, 2002; Westerbeek, 1999).

In the unconditional model, the mean reading achievement was 557.93 points. The second model, which accounted for the individual characteristics at Level 1, showed that boys did not score significantly lower than girls. With respect to the migration background, students whose parents were born in a country other than Germany achieved, on average, 28.28 score points fewer than students with parents who were both born in Germany. Students who had at least one parent born in Germany attained, on average, 15.86 score points fewer than students whose two parents were born in Germany. These findings represent a considerable achievement gap.

When we controlled for language spoken at home, we found an additional disadvantage for immigrant students. Students who never or sometimes spoke the test language at home had significantly lower scores on the reading test than students who always spoke the test language at home. Given that immigrants are twice as likely as nonimmigrants to be in a state of poverty (Beauftragte der Bundesregierung für Migration, Flüchtlinge und Integration, 2007), we can assume that these disadvantages in reading achievement for immigrant students in Germany can mainly be ascribed to the socioeconomic status of the family and, therefore, to the available resources that might be relevant to school learning. Students with medium and few home educational resources also scored significantly lower than students with high home educational resources. Students with low home educational resources especially showed (by more than 77 points) the highest disadvantage. Thus, socioeconomic status, migration background, and language spoken at home all had a significant influence on reading achievement.

After controlling for the individual variables, we introduced class-level variables to our (third) model in an attempt to explain the variance between the classes. In this third model, therefore, we considered the two composition variables. The proportion of students in a class who did not speak the test language showed a significant negative effect on reading achievement. The social composition of the class also exerted an effect on reading achievement. This variable was centered on its mean, which implies that in a class where 60% of the students have low educational resources, the reading

Table 3: Results of the HLM-Analysis

	Baseline model	Model with individual variables	Model with composition variables	Model with process variables
Reading achievement	557.93*** (2.55)	593.27*** (3.82)	591.52*** (3.79)	591.04*** (4.16)
Gender		-4.18 (2.47)	-4.20 (2.46)	-4.21 (2.46)
Language of test used at home (sometimes/never)		-9.50* (3.61)	-9.39* (3.95)	-9.39* (3.95)
One parent born in Germany		-15.86*** (3.95)	-15.40*** (3.99)	-15.42*** (4.00)
Neither parent born in Germany		-28.28*** (4.45)	-26.40*** (4.52)	-26.43*** (4.51)
Home educational resources (medium)		-26.74*** (3.70)	-27.06*** (3.59)	-27.06** (3.59)
Home educational resources (low)		-77.23*** (8.95)	-70.08*** (9.30)	-70.06*** (9.30)
Percentage of students who did not speak test language at home			-.56* (0.28)	-.56* (0.28)
Percentage of students with low educational resources at home			-1.41** (0.50)	-1.42** (0.51)
Teachers use a variety of organizational approaches (more than two)				1.55 (4.12)
<b>Variance components</b>				
Intercept	788.03***	541.94***	429.87***	432.48***
Level 1	2933.87	2674.13	2676.22	2675.76
$R^2$			.45	

achievement would be about 79 points lower than the average reading achievement in this calculated model. Both variables explained 45% of the variance of the intercept.

In our fourth and last model, we included the process characteristic denoting teachers' use of a variety of methods to organize their classroom teaching. As we observed earlier, a teacher who tends to use more than two methods (e.g., group work) offers students learning that is highly attuned to their individual learning needs and gives them access to different learning contents. This process characteristic showed a positive effect of about two points, but was non-significant. The linguistic composition of the class also had a non-significant effect.

## SUMMARY AND DISCUSSION

The results show that most of the variance in this model was at the level of the individual. However, the proportion of variance that could be explained by class membership was 21%, indicating that the class a child ends up in does influence his or her learning achievement. We endeavored to explain this difference by using composition and process characteristics at the class level. Composition variables are many and varied. They can relate to the social composition of the class or school (e.g., socioeconomic status, percentage of immigrant students, percentage of girls) and to the cognitive or achievement composition of the class or school (e.g., mean reading achievement). In our analysis, we used the percentage of students who did not speak the instruction language and the percentage of students with low home educational resources to account for the social composition of the class.

At the level of the individual student, our analysis found that several variables had significant effects on student reading achievement. These included gender, language spoken at home, migration background, and home educational resources. The reading achievement of students was on the low side if they sometimes or never spoke the test language at home, had parents who were not born in Germany, and had only medium or low educational resources. Language spoken at home emerged as a significant predictor of reading difficulty for immigrant students.

These results indicate the existence of educational inequality for a large part of the German student population in elementary schools. They also support the findings of other research on educational inequality (e.g., Becker & Lauterbach, 2004; Diefenbach, 2003; Ditton & Krüsken, 2006; Kao & Thompson, 2003). The achievement differences that we found between students from immigrant backgrounds and students from nonimmigrant backgrounds correspond with results reported for German elementary school students by Kristen (2008, p. 241) that we cited earlier in this article. She found that students whose two parents were not born in Germany were the group of students most disadvantaged with respect to educational achievement. Kristen also showed that this disadvantage was especially pronounced for students of Turkish descent.

These educational inequalities were also evident, in our study, at the class level. In classes with a high percentage of students with low educational resources, students' reading achievement was significantly lower than the reading achievement of students in classes with a medium to high level of resourcing. The proportion of students in the class who did not speak the test language at home also had an effect on the reading achievement of the students in that class.

These results correspond in part with other analyses conducted relative to the German education system. We again refer to Kristen's work. Kristen (2008, p. 241) showed that, in German elementary schools, the percentage of students who spoke the instruction language at home did *not* exert an effect if the cognitive composition of the class was also taken into account. However, Kristen did not consider the social composition of the class with regard to socioeconomic resources. In his analysis of

data on the reading achievement of students enrolled in Germany's secondary school system, Walter (2008, p. 177) found that cognitive composition had no effect if social composition and linguistic composition were also considered. The only significant composition effect that Walter found was social composition.

We can conclude from these findings that reading achievement depends on the social composition of the class, in particular the proportion of students in the class who have low educational resources. However, as is evident from our findings, the effect of composition variables such as this are often confounded, and we remain uncertain if other such variables are better (or not) predictors at the class level, such as mean reading achievement or student perception of school climate (e.g., how safe students feel at school).

Nonetheless, our findings suggest that educational inequality is a structural problem that affects the achievement of each student. Although we aimed, in this study, to gain a better understanding of the processes by which these composition effects may be transmitted, we were unable to offer new or additional explanation. And although we included in our analysis the process characteristic of teacher differentiation (i.e., teacher uses/does not use a variety of methods to meet the individual learning needs of students), we found no significant effect of a more learner-oriented teaching approach on reading achievement. Nor did this variable reduce composition effects: the effect of linguistic composition was no longer significant ( $p = .050$ ), but it was not effectively reduced.

We cannot, as yet, easily determine the importance of our findings within the context of current research on composition effects because only a very few studies concentrate on the transmission mechanisms. In Germany, analysis of data from PISA conducted by Baumert and colleagues (2003) shows that composition effects apparently are not transferred by peer-culture (e.g., school satisfaction, acceptance of achievement norms). As is evident from our descriptive analysis, classes with a composition likely to disadvantage student achievement show a higher variance in their achievement scores. In addition, teachers in these classes use a variety of instructional methods to differentiate between achievement levels. Controlling for the variety of teacher instructional methods might therefore be insufficient; teacher and student interactions at the micro level may also be important factors, and we did not account for these.

One consequence of our present understanding of composition effects is that the higher-level variables, such as teachers' competencies and school policies, tend to be the target of policymaking decisions and efforts centered on ameliorating educational inequalities. Other possible steps could be taken to reduce the effects of the social class composition. One such step might be to change school district boundaries or regulations so that students from different social backgrounds can learn together. Another approach might be to require schools to have specified proportions of their school enrolments made up of students from various backgrounds. Such measures, though, require a huge amount of administrative effort and financial cost. The results of "busing" in the United States suggest that this approach is unlikely to be a promising one (see, for example, Thrupp, 1995). And the deregulation of school districts, which

is already the case in some German Länder (states), could be counter-productive because parents might become even more prone to exercise choice over their child's school, thereby intensifying the homogeneous composition of the student body.

We consider, given the results of various studies in the elementary sector, that measures have to be taken to reduce achievement differences, especially those influenced by use of the instructional language, before children begin school. Also, at the class and school level, teachers and schools need more resources to cope with the learning needs of different student populations. Perhaps the "all-day school", a relatively new endeavor in Germany that aims to ensure student learning aligns with each student's individual learning needs, can be used to help enhance quality learning time and especially provide more time on task for students with few school-relevant resources and learning support at home. Another option might be to introduce mixed-age classes, where students with different ability levels learn together. Finally, more research is needed to determine the transmission mechanism of composition effects. Such research needs to take into account the normative and comparative culture of the class and teachers' expectations of student achievement.

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