

Linguistic diversity and students' reading achievements in developing countries: a hierarchical linear model analysis using PISA-D data

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Abstract

Research suggests that students from linguistically diverse settings may show better learning outcomes, especially at languages. However, existing studies on the topic are predominantly theoretical ones and focus on developed countries. This study empirically examines linguistic diversity and learning outcomes with respect to developing countries. Specially, it investigates the association between linguistic diversity and students' reading achievements and explores how consistent findings are across countries. It draws from PISA for Development 2018 data to compute two measures of linguistic diversity and uses hierarchical linear modeling for a quantitative empirical analysis. Results suggest that linguistic diversity as measured by the two approaches used in this study is not associated with students' reading achievements, and the lack of statistical association is consistent across countries. These findings seem to provide evidence showing that linguistic diversity does not influence learning outcomes.

Keywords: *linguistic diversity, Blau index, Herfindahl–Hirschman index (HHI), HLM, PISA for development*

Introduction

Classrooms in many countries comprise students from different cultures and with different linguistic backgrounds due to mass migration and a continuous increase in ethnic and sociocultural diversity in societies (Dotzel et al. 2021). Linguistic diversity is among the discussed factors in the discourse on education quality (Bredtmann et al. 2021). Dotzel et al. (2021) demonstrated how linguistic diversity is differently related to migrant and non-migrant students' performance in reading comprehension. They further highlighted the important role linguistic diversity can play in promoting student learning; for example, it facilitates new language acquisition. A linguistically diverse learning environment may increase students' language awareness and thereby improve their reading performance.

Societies are getting more and more globalized and diverse, and more and more students tend to be instructed in a second language rather than their first one (Nikula et al. 2016). In contexts such as in Sub-Saharan Africa, almost all learning settings are linguistically diverse (partly as a result of ethnic diversity), creating many challenges for teachers. As a consequence, a foreign language is used (e.g., French or English) as the sole or predominant language of instruction. Teachers face more and more challenges in increasingly linguistically diverse classrooms, and they recognize the implications of such settings for teaching and learning (Gkaintartzi et al. 2015). Research has shown the importance of linguistic diversity for better learning achievements (e.g., Busse et al. 2019, Piller 2016). However, most studies on the

topic remain theoretical ones, as empirical evidence is scarce. Moreover, there is a debate among the few empirical studies that investigated the relation between linguistic diversity and learning outcomes. For example, while some studies demonstrate that linguistic diversity improves students' learning outcomes (e.g., Busse et al. 2019), others suggest that there is no relationship between the two (Bredtmann et al. 2021). This indicates that there are mixed findings on the topic. Additionally, what is also noticeable is that related research is skewed towards high-income countries, leaving a gap with respect to low-and-middle-income ones. Therefore, it is critical to empirically examine the association between linguistic diversity and students' learning outcomes in the context of low-and-middle-income countries. This will provide a better understanding of how linguistic diversity is associated with learning outcomes across different contexts.

This study employs Program for International Student Assessment for Development (PISA-D), and its main purpose is to empirically examine the association between linguistic diversity and learning outcomes in four of the countries surveyed by the program¹. Specifically, it employs two measures of linguistic diversity often used in diversity research and it answers the following research questions:

- (1) What is the association between linguistic diversity and students' reading outcomes?
- (2) To what extent is the association consistent across the countries?

Based on previous studies, we hypothesize that linguistic diversity is positively associated with reading achievements (H1), and that the positive association is consistent across countries (H2). This cross-country study contributes to the literature by providing more evidence on the role of language in education from the perspective of countries with different socioeconomic and cultural backgrounds relative to high-income ones.

Linguistic diversity and its role in students' learning achievements

The relationship between language and academic achievements has been of much interest. Linguistic diversity has been increasing in many countries around the world, changing the linguistic composition of classrooms in these countries (Bredtmann et al. 2021). However, research suggests that teaching and learning in linguistically diverse classrooms is a significant challenge for both students and teachers (Dotzel et al. 2021, Phalet et al. 2004). The concept of linguistic diversity was approached in three ways by theoretical linguistics, namely language diversity, genealogical diversity, and structural variety (Hammarstrom 2016, Nettle, 1999). Among the three approaches, language diversity seems to be the most relevant to educational research (Busse et al. 2019). This approach defines linguistic diversity as the number of different languages spoken in a particular entity (e.g., geographic region, school), and it takes into account two key factors: first, speech patterns may be classified as discrete languages, and second, discrete languages can be counted. When applied to education, the approach implies that the more the languages spoken by students within a school or a classroom, the more linguistically diverse that setting is. Moreover, still from the perspective of the language diversity approach, an entity of high linguistic diversity is one where communication is poor and where an increase in communication leads to the rise of a *lingua franca*, imported or not (Greenberg 1956). This view is often referred to as the "monolingualism" approach, since it assumes that each individual speaks only a single language. On the other hand, it might be important to note that there is also a "polylingualism" approach to linguistic diversity, where every speaker is defined as speaking two or more languages. As such, in education, each student can be approached as a speaker of two or more languages.

¹ PISA-D surveyed eight countries, but this study investigates only four of them because there was very low linguistic diversity in the remaining countries. See the data section for details on countries

Linguistic diversity may be theoretically defined as ethnic diversity in itself because it is reasonable to think of the former as a result of the latter. However, the literature points out that even though the two share various similarities, they are not the same and have different implications for empirical research in education (Dotzel et al. 2021). For example, teachers dealing with ethnic diversity need strategies that take into account a wide range of student backgrounds (e.g., religions, values, attitudes). However, when dealing with linguistic diversity, teachers need strategies that account for the cognitive aspects of learning².

In the light of Jean Piaget's theory of disequilibrium and cognitive development (Piaget 1977), a linguistically diverse learning setting would increase learning because it creates a disequilibrium. As highlighted by Kibler (2011), students in such settings experience a state of cognitive disequilibrium (imbalance or conflict) that makes them uncomfortable and thereby drives them to seek ways to return to a state of equilibrium. In an environment where individuals encounter information that do not fit their existing schema, they tend to devote their cognitive energy to develop a new schema or adapt to the existing one. Consequently, they are cognitively stimulated as they seek to develop new schemas or extend existing ones.

Studies have demonstrated that learning quality may decline as a result of reduced stimulation of cognitive processes, and students' achievement may suffer from this (Driessen 2002, Peetsma et al. 2006, Van Ewijk & Slegers 2010, Rjosk et al. 2017). The process as presented in Piaget's theory may be linked to language awareness. Students in diverse linguistic settings are expected to have higher reading achievements because linguistic diversity creates an environment for a better understanding and knowledge of how languages function (Dotzel et al. 2021, Svalberg 2007). They face a linguistic conflict in these settings, which engages them to think about or question language rules and structures. These thinking skills can facilitate the learning process by helping students consider other perspectives and reflect on links between languages (van den Broek et al. 2022).

Despite the theoretical link explained, there is scarce empirical research on the association between linguistic diversity and students' learning outcomes. Among existing studies, Bredtmann et al. (2021) found that linguistic diversity is not related to grade 4 primary school students' learning achievements in Germany. However, Dotzel et al. (2021) investigated the same country using three different measures of linguistic diversity and found that the three measures show a positive relationship with grade 5 secondary school students' reading achievements. Similarly, an intervention study by Busse et al. (2019) highlighted that more linguistic diversity in schools is linked to better vocabulary learning. Furthermore, using the case of Sweden, Reierstam and Hellstén (2021) showed challenges teachers face in linguistically diverse settings when assessing students and how these challenges influence their students' learning outcomes.

In addition to scarcity of empirical studies on the relation between linguistic diversity and students' learning outcomes, literature is skewed towards high-income countries, leaving a gap with respect to low-and-middle-income ones. Mixed findings from existing studies seem to suggest that linguistic diversity may be important for learning outcomes in some contexts while it is not in others. Therefore, it is important to investigate the association between linguistic diversity and students' learning outcomes in different contexts in order to better understand the association across different contexts.

Data and methods

Data

This study uses data from PISA-D 2018, an international assessment covering seven low-and-middle-income countries: Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal, and Zambia. PISA-D draws on the framework of the Program for International Student Assessment (PISA) administered by

² See Glaz (2001) for details on the cognitive aspects of language diversity

the Organization for Economic Cooperation and Development (OECD), but it is designed to be more relevant to education in the context of low-and-middle-income countries. The program used different instruments to assess students' learning outcomes in reading, mathematics, and science, and it also collected contextual information to determine which factors influence these learning outcomes.

We employed data on four countries for the empirical analysis of this study, namely Guatemala, Paraguay, Senegal, and Zambia. This choice may be explained by the low linguistic diversity in the countries dropped from the sample. The target population of PISA-D consisted of students aged 15 and in grade 7 or higher. The sampling approach of PISA-D is known as a two-stage stratified design. In the first stage, the program had access to a national list of all eligible schools (those having eligible students or would have such students when the assessment is implemented) in each participating country, from which a sample of at least 150 schools were drawn in each country. The selection of schools was based on probability proportional to size, and the size of a school was measured as a function of the number of students attending that school and eligible for the program. In the second stage of the sampling approach, random selection technique was employed to select students from sampled schools. The program set a Target Cluster Size (TCS) of 42 students to be selected in each school, though the set TCS may be higher or lower for country-specific reasons. However, for schools that contained less than the TCS, all students were automatically included in the sample.

PISA-D ensured that technical selection standards were met in each country as to target student population coverage, accuracy and precision, and response rates from schools and students. For example, the standards in each country were to sample at least 150 schools and have a response rate of 85% and 80% from schools and students, respectively. The technical standards were met, and the sample used for the study provides information on students, their teachers, and their schools.

Variables

Students' reading achievement scores were used as a dependent variable in this study. This learning outcome seems to be more relevant relative to other subjects' outcomes when empirically assessing the theory on linguistic diversity and learning outcomes because studies suggest that linguistic diversity seems to be more relevant to language (Dotzel et al. 2021). The reading achievement variable captures students' abilities in understanding, engaging with, and using written texts in their respective language of instruction in relevant daily life contexts.

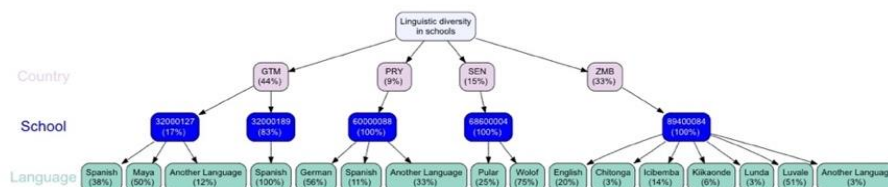
In order to capture linguistic diversity in each school, we followed Dotzel et al. (2021) and used the language students speak with their parents at home (home language) to compute two measures of linguistic diversity. Our approach implies that students speak a given language with their parents at home, as well as speaking the same language with their friends in school. For originality relative to previous studies, we relied on two different measures of the concept of linguistic diversity. Specifically, we used Blau Index and Herfindahl–Hirschman Index (HHI)³. The first measures the probability that two students randomly drawn from a given school belong to different linguistic backgrounds. As such, the higher the measure, the more linguistically diverse the school. The second was developed in economics to measure market concentration: the more a small number of companies dominates a given industry, the higher the HHI. Applied to language in a school setting, HHI measures language concentration or domination in the school setting. The higher HHI value, the more one language dominates the linguistic landscape of the school (i.e., high HHI indicates less linguistic diversity in the school).

³ See Guevara et al. (2016) for a technical description of these measures of diversity

The two measures of diversity used in this study account for two important dimensions of diversity⁴ that need to be analyzed jointly, i.e., variety and balance (Guevara et al. 2016). Variety is the number of categories or types an entity has. In the context of this study, variety refers to the number of languages present in a given school. For a better understanding of this dimension in our data, we randomly selected five schools from our sample and plotted a variable tree of language variety in each school (Figure 1). For example, the figure indicates that in Guatemala, while one language is spoken in a given school, three are spoken in another one. Therefore, language variety across schools can be different and this has different implications for student learning outcomes.

Balance is how much of each category the entity contains, that is, the proportion of each category in the entity. Applied to this study, balance refers to the abundance of each language relative to all languages present in a given school. Still referring to figure 1 and using a Zambian school as an example, we can see that Luvale is the dominant language (51%), followed by English (20%), Icibemba (14%), and Kiikaonde (6%). The languages with the lowest proportion in the selected school are Chitonga, Lunda, and “another language”, and all have a proportion of 3%.

Figure 1: Variable tree of language variety and balance from a sub-sample of the data



In addition to the variables of interest, we include a certain number of control variables, which are likely to also influence students’ learning achievements. These can be grouped into student background and school variables. For example, we controlled for student family socioeconomic status (SES) as a background variable and we also controlled for teacher being certified or not as a school-related variable. Tables 1 and 2 summarize all variables used in the study for the four countries⁵.

Table 1: Descriptive statistics of the samples for Zambia and Senegal

Variable	Zambia		Senegal	
	Mean	Std. Dev.	Mean	Std. Dev.

⁴Disparity, the third dimension often included in diversity measures, captures the dissimilarity between categories of an entity, i.e., how different the categories of an entity are (in this case how different languages in a school are), but our data does not allow us to include it

⁵ See OECD (2018) for details on variables

Student age	15.821	0.301	15.857	0.252
Male	0.523	0.5	0.535	0.499
Family SES	-1.277	1.337	-1.728	1.342
Grade repetition status				
Did not repeat	0.621	0.485	0.508	0.5
Repeated	0.379	0.485	0.492	0.5
Attitudes towards school	7.277	2.534	7.499	2.162
Every student has a textbook	2.696	0.58	2.263	0.974
HHI	0.596	0.263	0.794	0.24
Blau index	0.404	0.263	0.206	0.24
Public school	0.955	0.207	0.863	0.344
Class size	45.882	12.125	36.246	20.286
Class disciplinary climate	0.13	1.078	0.101	1.045
No certified teacher	0.371	0.483	0.09	0.287
Classroom teaching resources	3.79	0.642	3.533	0.655
Urban	0.467	0.499	0.618	0.486

Note: HHI: Herfindahl–Hirschman Index

Table 2: Descriptive statistics of the samples for Paraguay and Guatemala

Variable	Paraguay		Guatemala	
	Mean	Std. Dev.	Mean	Std. Dev.
Student age	15.718	0.296	15.776	0.286
Male	0.506	0.5	0.482	0.5
Family SES	-1.185	1.113	-1.299	1.203
Grade repetition status				
Did not repeat	0.787	0.409	0.647	0.478
Repeated	0.213	0.409	0.353	0.478
Attitudes towards school	7.364	1.94	7.807	1.908
Every student has a textbook	1.622	0.858	0.964	0.91
HHI	0.818	0.222	0.912	0.163
Blau index	0.182	0.222	0.088	0.163
Public school	0.737	0.44	0.523	0.5
Class size	34.152	20.416	35.784	15.046
Class disciplinary climate	-0.2	0.987	0.177	0.968
No certified teacher	0.347	0.476	0.35	0.477
Classroom instructional resources	4.452	1.108	4.396	1.195
Urban	0.714	0.452	0.696	0.46

Note: HHI: Herfindahl–Hirschman Index

Analysis

We used hierarchical linear modeling (HLM) to estimate the association between linguistic diversity and students' reading achievements. HLM is one of the commonly used statistical modeling when data employed in a study present a nested or grouped structure (Hofmann 1998). In the context of this study, students are nested in schools, and this nesting makes those from a given school share more similarities relative to others from another school. As such, schools also have a non-negligible influence on students' performance. HLM allows an estimation of predictors affecting students' learning outcomes while at the same time accounting for the group-level effect (Woltam et al. 2012).

We started the analysis by checking whether the data fits the model, through an estimation of an empty model for each individual country. The empty model helped obtain the intraclass correlation, a measure of variance due to differences across schools. After estimating the empty model, we included predictors from a stepwise approach, by adding student-level predictors and then school-level ones. Our variables of interest are school-level ones and were added accordingly with other school variables.

For each measure of language diversity that we used in the study, we fitted an HLM model across countries separately. PISA-D data is similar to most international educational assessments, as cognitive outcome variables are provided as plausible values (PV). We estimated models for each of the ten PVs provided in the data while including school weight, and the average over these ten calculations provided more robust estimates (Mang et al. 2021, Rubin 1984). We checked model fit by using the deviance statistic ($-2 \times \log$ likelihood), where a larger deviance for a more complex model indicates a poor fit of that model relative to the less complex one (Anderson 2012). Moreover, unlike some studies centering variables in analyses using HLM, we did not center variables before the analysis. This empirical choice was motivated by studies showing that the practice of centering may lead to an estimation of a model different than the one intended (Hofmann & Gavin 1998, Ita et al. 1995, Paccagnella 2006).

Results and discussion

Tables 3 and 4 show the results of the association between linguistic diversity measured as the Blau Index and students' reading achievements in the four countries investigated by this study. The analysis was performed using HLM and the ten plausible values provided in the dataset as dependent variables. The tables indicate a positive association between the measure of linguistic diversity and students' reading achievements in Zambia, but a negative association between the two variables in Senegal, Guatemala, and Paraguay. However, across the four countries, the association shown is not statistically significant. Therefore, it can be said that from the perspective of the Blau Index, linguistic diversity is not statistically associated with reading achievements, and results are consistent across the four countries.

Tables 5 and 6 show the results on the association between diversity as measured by HHI and students' reading achievements. Similar to the case of the first measure of linguistic diversity, the analysis was performed using HLM and the ten plausible values provided in the dataset as dependent variables. Results indicate a negative association between the variable HHI and students' reading achievements in Zambia, but a positive association between the two in Senegal, Guatemala, and Paraguay. However, the coefficient for this predictor is not statistically significant across the four countries. In other words, linguistic diversity as measured by HHI is not associated with students' learning achievements, and the lack of association seems to be consistent across the four countries investigated.

From an overall perspective, our findings suggest that linguistic diversity is not associated with students' reading achievements, regardless of the diversity measure that we used, and regardless of the country. These findings do not confirm our hypotheses, which expected a positive and consistent relationship between our measures of linguistic diversity and students' reading achievements across the four countries investigated. The findings are inconsistent with previous studies, which showed that linguistic diversity improves students' achievements (Dotzel et al. 2021). Our null and different results might be explained by the key difference in contexts when comparing our study to previous ones. Most

previous studies were conducted on developed countries, where linguistic diversity is closely related to migrant or non-native speaker background. For example, in the study of Dotzel et al. (2021), 59% of the students in the sample have a migration background. However, in the context of our study, the countries investigated are low-and-middle-income ones, and almost all students are originally from their country of residence.

Our findings are not in line with Piaget's disequilibrium theory (1977), which suggests that the theory may not necessarily be supported in all contexts, at least in the contexts we investigated. It may be that there is not enough level of disequilibrium for students to interact in order to modify or create new schema. This situation is very likely to be expected in Guatemala and Paraguay, where our data shows that there is a lower level of variety of languages in these countries relative to Senegal and Zambia. In other words, a higher level of disequilibrium might be expected from Senegal and Zambia where there is a higher variety of languages used.

Our findings may also suggest that for students to cognitively profit from linguistic diversity, schools need to capitalize on the variety of linguistic resources that linguistic diversity provides (Goduka 1998). Reierstam and Hellstén (2021) support this by demonstrating in the context of Sweden that when schools leverage the strengths and resources offered by linguistic diversity, this helps improve student learning achievements. Unfortunately, this practice of capitalizing on linguistic diversity resources is likely not to be common in countries like the ones we investigated. Such countries tend to use a "borrowed" language as a medium of instruction and do not invest much in local languages in terms of their potential for better quality education (Stroud 2001). In these countries, current linguistic practices in schools might need to be reconsidered in order to find approaches, which benefit learners and improve education quality.

Table 3: Results on the association between linguistic diversity measured as Blau index and students' readings achievements

Variable	Zambia			Senegal		
	Coefficient	std.error	Sig	Coefficient	std.error	Sig
Intercept	158.28	67.569	***	271.996	120.803	***
Age	7.857	3.696	**	-1.986	7.653	
Male	-0.259	2.329		-3.764	3.788	
Family SES	3.877	1.001	***	-1.445	2.074	
Attitudes towards school	4.002	0.457	***	3.498	0.959	***
Grade repeater	-9.865	2.03	***	-10.941	5.275	*
Every student has a textbook	-83.385	46.018	*	17.033	19.65	
Blau index	5.032	5.14		-12.076	11.164	
Public school	-37.04	14.918	**	-10.868	14.952	
Class size	-0.527	0.29	.	0.303	0.184	
Class disciplinary climate	8.124	1.087	***	-0.801	2.23	
Not certified teacher	-0.083	0.072		-0.196	0.147	
Classroom instructional resources	13.809	3.799	***	10.122	4.661	**
Urban	36.423	6.711	***	23.614	7.468	**

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Results on the association between linguistic diversity measured as Blau index and students' readings achievements

Variable	Guatemala			Paraguay		
	Coefficient	std.error	Sig	Coefficient	std.error	Sig
Intercept	246.584	62.608	***	304.486	77.781	***
Age	5.411	3.744		3.823	4.949	
Male	-2.865	2.546		14.328	3.055	***
Family SES	7.479	1.365	***	9.552	1.376	***
Attitudes towards school	1.121	0.652	.	-0.316	0.728	
Grade repeater	-23.089	2.568	***	-37.11	3.484	***
Every student has a textbook	14.238	6.739	**	19.288	10.857	*
Blau index	-7.026	11.706		-2.144	8.325	
Public school	-7.409	7.162		-30.054	7.011	***
Class size	0.006	0.189		0.181	0.165	
Class disciplinary climate	2.318	1.067	**	3.434	1.515	**
Not certified teacher	-0.033	0.127		-0.081	0.077	
Classroom instructional resources	5.544	2.196	**	3.109	2.289	
Urban	37.196	7.139	***	23.054	6.337	***

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Results on the association between linguistic diversity measured as HHI and students' readings achievements

Variable	Zambia			Senegal		
	Coefficient	std.error	Sig	Coefficient	std.error	Sig
Intercept	163.312	67.303	**	259.92	123.481	**
Student age	7.857	3.696	**	-1.986	7.653	
Male	-0.259	2.329		-3.764	3.788	
Family SES	3.877	1.001	***	-1.445	2.074	
Attitudes towards school	4.002	0.457	***	3.498	0.959	***
Grade repeater	-9.865	2.03	***	-10.941	5.275	.
Every student has a textbook	-83.385	46.018	*	17.033	19.65	
HHI	-5.032	5.14		12.076	11.164	
Public school	-37.04	14.918	**	-10.868	14.952	
Class size	-0.527	0.29	.	0.303	0.184	
Class disciplinary climate	8.124	1.087	***	-0.801	2.23	
Not certified teacher	-0.083	0.072		-0.196	0.147	
Classroom instructional resources	13.809	3.799	***	10.122	4.661	***
Urban	36.423	6.711	***	23.614	7.468	***

*** p<0.01, ** p<0.05, * p<0.1 Note: HHI: Herfindahl–Hirschman Index

Table 6: Results on the association between linguistic diversity measured as HHI and students' readings achievements

Variable	Guatemala			Paraguay		
	Coefficient	std.error	Sig	Coefficient	std.error	Sig
Intercept	239.558	63.729	***	302.342	78.849	***
Student age	5.411	3.744		3.823	4.949	
Male	-2.865	2.546		14.328	3.055	***
Family SES	7.479	1.365	***	9.552	1.376	***
Attitudes towards school	1.121	0.652	.	-0.316	0.728	
Grade repeater	-23.089	2.568	***	-37.11	3.484	***
Every student has a textbook	14.238	6.739	**	19.288	10.857	*
HHI	7.026	11.706		2.144	8.325	
Public school	-7.409	7.162		-30.054	7.011	***
Class size	0.006	0.189		0.181	0.165	
Class disciplinary climate	2.318	1.067	**	3.434	1.515	**
Not certified teacher	-0.033	0.127		-0.081	0.077	
Classroom instructional resources	5.544	2.196	**	3.109	2.289	
Urban	37.196	7.139	***	23.054	6.337	***

*** p<0.01, ** p<0.05, * p<0.1 Note: HHI: Herfindahl–Hirschman Index

Conclusion

Linguistic diversity in schools is one of the factors that may influence education quality. Previous studies suggest that students studying in linguistically diverse settings have better learning outcomes, mainly in language. Despite these findings, evidence on how linguistic diversity is associated with learning outcomes is predominantly theoretical, and empirical evidence scarce with respect to low-and-middle-income countries. Therefore, this study addressed this gap by examining the association between linguistic diversity and reading achievements in four low-and-middle-income countries, and it explored how consistent the estimates are across these countries. The study used two measures of linguistic diversity and Hierarchical Linear Modelling as a method. The analysis revealed that linguistic diversity as measured by the two approaches used in this study is not associated with students' reading achievements, and the lack of association is consistent across countries.

Findings indicate that linguistic diversity, at least, does not hinder learning in low-and-middle-income countries. The practical implications of this study are that the evidence to support either monolingualism or multilingualism in educational settings is weak. In other words, there is no single model that would fit all contexts or would solve issues in all contexts. Consequently, each educational system needs to find a relevant strategy to respond to linguistic diversity in its context, if they want students to benefit from it. From this perspective, Sierens and Avermaet (2014) proposed the capitalization of functional multilingual learning, i.e., a pedagogical approach that makes use of children's linguistic resources in the teaching and learning process. This approach may be promising in terms of how linguistic diversity may contribute to better education quality in schools.

Our study is to be interpreted while considering a certain number of limitations worth noting. First, we used only two measures of linguistic diversity, but there are other measures that can be used. Future research may replicate this study using different measures of linguistic diversity. Closely related to the

measures of linguistic diversity is that the study employed students' home language to compute diversity indices. There was a lack of variables capturing the linguistic behavior of students at school, and the variable used (student home language) assumes that each student is monolingual; however, it may be that some of them are bilingual or multilingual. Therefore, with availability of better data, future studies may help better capture the concept of linguistic diversity by including variables that capture actual linguistic interactions in school settings. Second, the package used to compute linguistic diversity measures does not allow an evaluation of the comparability of the constructs across countries. In other words, the construct used may vary across countries and make comparability challenging. This is a limitation that future studies could try to address. And third, we used only reading achievements as a measure of learning outcomes. Given that linguistic diversity may be relevant for other subjects, we suggest that future studies use other measures of learning outcomes.

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