

Cultural Diversity and Student Achievement

The Moderating Role of Teachers' Diversity-Related Attitudes

Master's Thesis

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Abstract

As the proportion of children with cultural minority backgrounds rises in German schools, interest in the effects of cultural diversity on student outcomes has increased. Empirical findings on this effect have been inconsistent up to now. While a positive effect of cultural diversity on achievement through improvement of cognitive development, divergent thinking and minority students' feeling of belonging seems likely, an unmediated effect is theoretically less plausible. This paper also explores the possibility that teachers' attitudes towards diversity could moderate the effect of cultural diversity on student achievement by positively affecting instructional quality. Both the effect of cultural diversity and the possible moderation through teacher attitudes are investigated using data on the reading achievement of $N = 1614$ German fifth-graders. Multilevel analyses find no significant effect of the variety of cultural backgrounds beyond the proportion of minority students. Possible reasons for this are explored in follow-up analyses and discussed. Teachers' attitudes also did not emerge as a significant moderator of this relationship, leading to a discussion on the aims of current political programmes promoting teachers from cultural minority backgrounds with the understanding that they show more positive attitudes towards diversity. It is also concluded that future research could focus more strongly on social processes as mediators of the diversity-achievement effect.

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The proportion of students with an immigration background in German classrooms has risen steadily over the last years. In 2019, 37.5% of students had an immigration background according to the German microcensus (Statistisches Bundesamt, 2020, p. 47), compared to 28.3% in 2010 (Statistisches Bundesamt, 2017, p. 34). As the diversity in classrooms increases, there is a rising interest in its effects on student achievement, since this information can be used in the adaption of learning environments to the changing student body. Knowledge of the effects of cultural diversity is also needed to inform political decisions regarding student allocation to schools, especially in the context of ensuring equal opportunities for students with an immigration background. These students often visit schools with a higher percentage of minority students while already being disadvantaged in the German education system (Seuring et al., 2021). However, cultural diversity in the classroom affects not only students. It also poses a challenge to teachers, who have to meet the needs of a growingly diverse classrooms with the limited time and resources given to them (Gebauer & McElvany, 2020; Hachfeld, 2013).

This paper discusses the theoretical and methodological reasons for the current mixed findings regarding the effects of diversity on student achievement. In the context of an open research question, the effect of cultural diversity on students' reading achievement will then be tested in multilevel models, using various indicators of diversity.

The role of teachers' attitudes is discussed as a relevant factor in dealing with increasingly diverse classrooms. Attitudes towards cultural diversity can influence teachers' readiness to acknowledge cultural differences in their instruction and may improve teaching practices by promoting teachers' enthusiasm and intrinsic motivation (Gebauer & McElvany, 2020; Gutentag et al., 2018; Hachfeld et al., 2012). In this paper, teachers attitudes towards diversity are hypothesised and tested as a moderator of the diversity–achievement relationship. By examining this previously untested moderator, this article contributes to the current understanding of cultural composition effects. Findings on teacher attitudes as a moderating factor can also give indications of the usefulness of current political concepts that aim to increase the proportion of teachers with an immigration background, based on the premise that those teachers report more positive diversity-related attitudes (Syring et al., 2019).

Cultural Diversity in the Classroom

Cultural diversity or heterogeneity describes the variety of cultural backgrounds within a group of students. The description is made in comparison to other groups and is temporarily limited – as the composition of a classroom changes, its diversity can change (Budescu & Budescu, 2012; Trautmann & Wischer, 2011). The most common outcome variable that has been studied in relation to aspects of classroom composition like cultural diversity has been academic achievement (van Ewijk & Sleegers, 2010). Interest in the effects of cultural classroom composition has increased in the last years, as more and more students in German classrooms have an immigration background (Statistisches Bundesamt, 2020). Students with an immigration background seem to be disadvantaged in the German education system, they attend lower educational tracks and can show lower average achievement (Seuring et al., 2021). Due to existing geographical segregation of cultural groups, migrant students are also more likely to attend classrooms with a high proportion of other minority students (Lenz et al., 2019; Mok et al., 2016). Knowing how cultural classroom composition affects students' academic outcomes is an important basis for political decisions regarding student allocation to schools, especially when they aim to promote equal opportunities for all students.

Neither theoretical predictions nor empirical findings regarding the effects of cultural diversity (hereafter called “diversity” for short) are clear-cut. Historically, studies have often operationalised diversity as the proportion of cultural minority students, with a higher proportion implying a more diverse classroom. Studies using this measure find predominantly negative effects of diversity on student achievement (see Mickelson et al., 2020; Mok et al., 2016). Explanations for these negative effects include lower teacher expectations for the achievement of students in classrooms with a high proportion of minority students, which could lead to them offering less challenging instruction to these classrooms. Detrimental beliefs and values towards achievement shared by minority students are also thought to be responsible for this negative relationship. On a more structural level, lower achievements in classrooms with a higher minority proportion have been explained by a lack of resources – be it money or highly qualified teachers – in schools in economically disadvantaged areas that are visited by more minority students (Rjosk et al., 2017).

This way of operationalising cultural diversity has recently come under criticism because the measure of minority share does not differentiate students' background beyond

minority status. Thus, it does not adequately represent the variety of cultural backgrounds in a classroom (Rjosk et al., 2017). Instead, several studies now use indices of heterogeneity like the number of cultural backgrounds in a classroom, but also more complex measures that incorporate the number of cultural backgrounds and the relative proportions of students from different backgrounds. The results of these studies are mixed, although they show mostly small positive effects (Benner & Crosnoe, 2011; Braster & Dronkers, 2015; Rjosk et al., 2017; Tam & Bassett, 2004).

The following section will first describe the theoretical and empirical findings pointing to a positive effect of diversity on achievement. It will then discuss evidence against this effect, adding to the discussion on diversity effects.

Cultural Diversity as a Positive Predictor of Academic Achievement

Several theoretical mechanisms predict positive effects on academic achievement in culturally diverse classrooms: In classrooms with a diverse range of cultural backgrounds, students are exposed to a wider variety of worldviews, experiences and views. Based on Piaget's theory of disequilibrium, resolving discrepancies between these views and experiences fosters the cognitive development of students, which benefits academic achievement (Lloyd & Fernyhough, 1999). Similarly, diverging views and experiences in diverse classroom are assumed to increase achievement by promoting creativity and divergent thinking (Benner & Crosnoe, 2011; Konan et al., 2010; Tam & Bassett, 2004). Wölfer and colleagues (2019) view cultural differences in views and ideas as social capital that can be exchanged during outgroup contact. In diverse classrooms, more opportunities for outgroup contact and thus exchange should arise, enhancing achievement. Diversity also affects social outcomes that can increase student achievement: A feeling of belonging to a classroom or school is associated with stronger learning engagement and higher academic achievement (Rjosk et al., 2017; Schachner et al., 2019). There is some discourse on whether minority group membership or specific cultural backgrounds are relevant in constructing feelings of belonging (Benner & Crosnoe, 2011; Rjosk et al., 2017). However, diversity has shown beneficial effects on feeling of belonging (Schachner et al., 2019).

The discussed mechanisms match the reasoning on the way classroom composition affects student outcomes. They can all be seen as diversity affecting achievement through peer processes, which have been one of the factors assumed to mediate the relationship between classroom composition and learning (Rjosk et al., 2014). Theoretically, it seems sound to assume a positive effect of diversity on student achievement.

Empirical findings also support this: Studies using diversity indices often show positive effects of diversity on achievement. Tam and Bassett (2004) find that high school freshmen from more diverse schools show higher GPAs. Braster and Dronkers (2015) find similar results, though the positive effect on (mathematics) achievement was only significant for minority students. In a study by Benner and Crosnoe (2011), school diversity positively predicts reading and mathematics of kindergarten students when the proportion of same-ethnicity peers is included in the analysis. Rjosk and colleagues (2017) find a small positive effect of classroom diversity, measured by multiple diversity measures, on students' reading achievement after controlling for the proportion of minority students.

Does a Direct Effect of Cultural Diversity on Achievement Exist?

So far, theoretical and empirical evidence for a positive effect of diversity on achievement has been presented. However, the following section will call the existence of a direct effect of cultural diversity, as tested in this study, into question.

Theoretically, the effect of cultural diversity is generally not assumed to be a direct one. Instead, classroom composition is thought to affect achievement and other outcomes by influencing variables like the aforementioned peer processes and instructional quality. These in turn influence outcome variables like academic achievement, mediating the effect of diversity (Fauth et al., 2021). The theoretical arguments laid out in the last section also employ this argument and presume the relationship between diversity and achievement to be mediated by other variables. According to the theory of disequilibrium, e.g. encountering diverging opinions in diverse classrooms should enhance cognitive development. Students more advanced in cognitive development should in turn show higher academic achievement (Lloyd & Fernyhough, 1999). As such, one theoretically would not expect the existence of a direct, unmediated effect of cultural diversity on achievement.

Next to peer processes and school resources, teaching quality is the third mediating factor through which classroom composition is assumed to affect outcome variables. For the outcome of academic achievement, it is perhaps the most salient one (Fauth et al., 2021; Rjosk et al., 2014). For the classroom composition to affect student outcomes, especially academic ones, it should have an influence on teaching and the way teachers deliver instruction. However, teachers may not necessarily adapt their instruction to the cultural composition of a classroom. While investigating the effect of different classroom composition variables on teaching quality, Fauth and colleagues (2021) show that cultural classroom composition does not significantly affect any aspect of teaching quality. Instead, cognitive and motivational composition emerge as significant predictors of teaching quality. Similarly, Wenger and colleagues (2020) find that the school-level percentage of students with a migration background does not significantly predict classroom management or individual learning support as aspects of teaching quality.

In summary, these results indicate that classroom composition can influence teaching quality and classroom management and could affect academic outcomes through this. However, other classroom characteristics seem to be more salient to teachers in adjusting their instruction than cultural background. If teachers do not take cultural diversity into account during their instruction, it seems unlikely that diversity would influence achievement as an outcome of instruction.

Even if cultural classroom composition may be a relevant factor to some teachers' instruction, it is unclear whether they possess the competencies necessary for diversity-sensitive teaching: The results of a study conducted on pre-service teachers by Keppens and colleagues (2019) showed that participants had difficulties implementing adequate teaching practices in diverse classrooms. The instructional practices of interest were *differentiated instruction* and positive *teacher-student-interactions*. To adequately utilise these, teachers need to recognise classroom events that could affect student learning and require or would facilitate certain instructional practices. They should then be able to adequately interpret events in light of their professional knowledge in order to implement appropriate teaching practices in a beneficial way. However, no group of participants in Keppens' study showed abilities on the same level as experts in recognising and interpreting information regarding both teaching practices (Keppens et al., 2019). Correctly understanding classroom processes seems to be a skill that

needs to be practiced and developed. Especially younger teachers might thus be aware of the importance of cultural diversity for teaching but unable to adjust their instruction accordingly. Diversity would not be a significant factor in their instruction, making it difficult and unlikely for any positive effects on achievement to occur.

Many of the empirical studies finding positive effects of diversity on achievement test this as a direct effect. From a methodological point of view, these results not give reason to presume the existence of a direct effect either though. When testing the effects of diversity empirically, studies rarely include possible mediating variables in their analysis. Instead, they overwhelmingly test the direct relationship between diversity and achievement (see Braster & Dronkers, 2015; Rjosk et al., 2017; Tam & Bassett, 2004). Variables and processes that could mediate this effect are only discussed theoretically or partially tested in separate analysis (see Rjosk et al., 2017). The only exception to this is the study by Schachner and colleagues (2019). In their model and subsequent analysis, they explicitly set out the feeling of school belonging as a mediator of the effects of student and classroom level variables, including cultural diversity, on achievement, academic self-concept and life satisfaction. In contrast to similar studies, their analysis does not include the direct effect of diversity at all on the other hand. When the effect of diversity on achievement is tested without including any assumed mediating variables in the analysis, this makes it difficult to evaluate whether any detected relationship actually constitutes a direct effect. If the relationship were mediated, which most studies assume but do not test, including this mediating variable in the analysis would diminish the direct effect of diversity that was previously found (Baron & Kenny, 1986). Since, as of now, no study has analysed both the unmediated effect of diversity and possible mediators, we cannot interpret the existing empirical findings as evidence for the existence of a direct causal relationship between cultural diversity and achievement. This is especially the case since theoretical considerations also suggest the relationship to be mediated.

To summarise, there is a sound theoretical argument to be made that cultural diversity positively influences students' academic achievement. Plausible mechanisms for this include beneficial effects of the exchange of diverging opinions and experiences on cognitive development and creativity, but also a higher feeling of belonging for minority students in diverse classrooms. Recent empirical results support this, finding small positive effects of

diversity on achievement in different subjects. It has to be qualified, however, that these studies overwhelmingly do not include any mediating variables in their analysis. Thus, it is not possible to determine whether the effects found constitute evidence for a direct effect of diversity on achievement or whether they are the result of an untested mediation. Additionally, cultural classroom composition may not be one of the most salient influences on the actual choices of teachers when it comes to their instruction. Because of this, it can be argued that it is unlikely for cultural diversity to directly influence academic outcomes without any mediating processes. This complicates making assumptions when testing the direct effect of cultural diversity on achievement, as this study intends to do.

Teachers' Attitudes Towards Diversity

As described in the previous sections, cultural diversity is associated with differing views and experiences between students of different cultural origin. This has the potential to positively affect cognitive, social and academic outcomes within a classroom. To reap this positive potential of diversity, teachers should try to incorporate diverging views, experiences and values in their teaching and foster a climate of cultural pluralism, in which different experiences are embraced as a resource for mutual learning (Schachner et al., 2019). Embracing diverging experiences and views can also help students to better connect with the material taught in class and thus foster learning outcomes (Gebauer & McElvany, 2020; Hachfeld, 2013). Yet, teachers also need to be mindful of diverging needs of students that come with their cultural backgrounds. This entails catering to varied levels of language skills and prior knowledge for students with a more recent immigration history. Teaching in culturally diverse classrooms thus puts additional demands on teachers in order to adequately react to different cultural backgrounds in their instruction. To master this additional challenge, a higher amount of intrinsic motivation and effort is required from teachers (Syring et al., 2019).

One factor that influences not only teachers' motivation to handle diversity but also the way they plan and deliver instruction in diverse classrooms is their attitude towards diversity. Attitudes refer to psychological tendencies towards a certain object that can be positive or negative in value. They consist of cognitive and behavioral components that influence the reactions of attitude holders (Eagly & Chaiken, 1993). In a school context,

attitudes can affect teachers' perception and judgement of students, their emotions towards students as well as their behavioral reactions to students in the classroom. By shaping teachers' value systems, attitudes can also influence teacher-student-interactions during teaching (Bello & Ehmke, 2017; Eagly & Chaiken, 1993; Gebauer & McElvany, 2020).

Positive attitudes towards cultural diversity could thus affect various aspects of classroom events. Previous studies indicate that they are beneficial for teachers' handling of cultural diversity. For example, pre-service teachers holding more positive attitudes towards teaching culturally diverse classes report stronger intentions to incorporate cultural diversity into their teaching (Gebauer & McElvany, 2017). This has also been confirmed for in-service teachers. Gebauer and McElvany (2020) found a positive correlation between the perceived usefulness of cultural diversity (as an aspect of their attitudes towards diversity) and teachers' adaptation of their instruction to culturally diverse classrooms ($\gamma = .42, p < .05$). While teaching, positive attitudes towards diversity are also beneficial: Teachers with more positive attitudes towards diversity also show a higher intrinsic motivation ($r = .45, p < .01$) to teach culturally diverse students. Teachers show increased self-efficacy and enthusiasm while teaching culturally diverse classrooms when they report stronger multicultural beliefs. This means that they acknowledge cultural differences and support their inclusion during classroom instruction. When cultural diversity was seen as an asset instead of a problem or burden, teachers also reported less diversity-related burnout symptoms (Gutentag et al., 2018; Hachfeld et al., 2012).

In sum, a positive teacher attitude towards cultural diversity seems to improve the handling of classroom diversity in two ways. It increases teachers' readiness to incorporate diversity in their teaching, making it possible for the potential of culturally diverse views and experiences to emerge. Positive attitudes towards diversity also positively affect teachers during instruction by increasing enthusiasm and self-efficacy, both of which could lead to a higher quality of instruction and improve student achievement. Because of this, I assume that the positive effects of cultural diversity are more likely to emerge in classes taught by teachers with a positive attitude towards diversity. The effect of diversity on achievement could also be stronger in those classrooms, since it is likely mediated teaching quality. Higher enthusiasm, intrinsic motivation and self-efficacy, as shown by teachers with more positive attitudes

towards diversity, are likely to result in a higher quality of instruction. Based on this reasoning, teacher attitude is proposed as a mediator of the effect of diversity on achievement.

Research Questions

The aim of this study is to test the effect of cultural diversity, operationalised through several diversity measures, on students' reading achievement. By using various diversity measures, it builds on the findings of Rjosk and colleagues (2017) and expands on them by using longitudinal instead of cross-sectional data. The analysis will examine the following research question:

1. Does the cultural diversity of a classroom have an effect on students' reading achievement?

Through mechanisms like an increase in creativity and divergent thinking, but also by fostering minority students' feeling of belonging, cultural diversity can positively affect student achievement. However, an unmediated effect as tested in this study likely does not exist, though it might be found in analyses if no mediating variables are included. It is also still unclear if cultural diversity is a relevant enough factor in teachers' instructional decisions for it to significantly influence academic outcomes. Based on the current state of knowledge, I do not make an assumption on the direction of the effect of cultural diversity on achievement. Instead, the effect is tested within the scope of an open research question. In a second step, the influence of teacher attitudes regarding diversity is tested.

2. Do teachers' attitudes towards cultural diversity moderate the relationship between cultural diversity and reading achievement?

No studies have tested teacher attitude as a possible moderator of the diversity–achievement relationship so far. Still, teachers with a more positive attitude towards diversity are more willing to incorporate and utilise cultural diversity in their instruction. Additionally, positive teacher attitudes increase their enthusiasm and motivation, which could benefit instructional quality. Based on this, I expect a stronger and more positive effect of cultural diversity on reading achievement in classrooms taught by teachers with a more positive diversity-related attitude.

Method

Design and Sample

To test both research questions, this study utilises the dataset of the VESPER study conducted at the University of Mannheim during the 2018/19 school year. The data were collected in fifth-grade classrooms at the beginning of the school term in September 2018 and at the end of the school term in January and February 2019. At this points of measurement, students filled out a questionnaire evaluating their reading achievement. The students' German teachers filled out questionnaires at the beginning and end of the school term as well. These questionnaires assessed among others teachers' instruction, attitudes towards heterogeneity and professional knowledge.

The original sample consisted of 79 classes from four different school types. 27 classes completed a reading strategy intervention during this term, as the original aim of the VESPER study was to evaluate the effectiveness of this training. The intervention showed no significant effects and is controlled for during later analyses (Karst et al., 2020). For this study, the 2 classes belonging to the school type *Werkrealschule* were excluded, as the number of students in this school type was too low to be used in the analysis of school type effects. Any classes with less than 15 students were also excluded, since the calculation of diversity indices for such a small number of students would have been futile. In the end, the sample for this study consists of $N = 1614$ students from 67 classes and 25 schools. Of those classes, the majority belonged to the highest secondary school form *Gymnasium* ($N = 50$). 10 classes belonged to *Realschulen* and 7 to *Gemeinschaftsschulen*. The number of students in a classroom ranged from 16 to 31 students ($M = 24.63$, $SD = 3.49$). All students visited the 5th grade with a median age of $M = 10.17$ years ($SD = .49$), 51% of students were female.

Within the sample, 54% of students were classified as having an immigration background, meaning they had at least one parent born outside of Germany. 86 different countries of origin could be identified, the most common except for Germany being Turkey (9.9%), Russia (5.3%) and Italy (2.6%). If both of a child's parents had different non-German countries of origin, the child was classified as having an immigration background, but the country of origin was coded as undeterminable (see Statistisches Bundesamt, 2020). This was the case for 8.5% of children.

Variables and Operationalisation

Reading Achievement

For the first point of measurement, the *Lernstand 5* served as the measure of students' reading achievement. The *Lernstand 5* is a mandatory test of reading achievement conducted in 5th grades in the German federal state of Baden-Württemberg (IBBW, n.d.). To measure reading achievement at the end of the school term, a parallel version of this test was developed. Reading achievement at the second point of measurement was the dependent variable in all analyses, with reading achievement at the beginning of the term controlled for.

Teachers' Attitudes Towards Cultural Diversity

Teachers' attitudes were measured at the beginning of the term with the cultural heterogeneity subscale of the instrument developed by Lehmann-Grube and colleagues (2017). This scale uses a semantic differential to measure the general valence of cultural diversity, the perceived usefulness for students and perceived costs for the teacher. The instrument starts with the following sentence (translate).

For teaching in my subject of German, I consider the diversity of students regarding their immigration background to be...

Subsequently, teachers are presented with pairs of opposing words, between which they can indicate their answers on a five-point Likert scale. The reliability of the whole instrument was $\alpha = .86$, with reliability analysis indicating that the reliability could not be improved by removing any items or subscales from the scale. Thus, all 10 items were used to calculate a mean score of teachers' attitudes, with a higher score indicating a more positive attitude towards cultural diversity.

Diversity Measures

All diversity measures used the demographic information that students provided in the first questionnaire in September 2018. The percentage of students with an immigration background p_{Mig} was calculated for every classroom. As previously mentioned, this measure does not fully capture the diversity of cultural backgrounds within a classroom. It is, however, a relevant measure of classroom composition and is included in the analyses as such. In a second step, p_{Mig} is used as a control variable to determine whether measures of cultural diversity influence reading achievement beyond the effects of minority proportion (see Rjosk et al., 2017 for a similar analytical strategy).

I calculated two more measures that more adequately capture the various cultural backgrounds within a classroom. The first, number of categories $Ncat$, identifies the number of non-German cultural backgrounds within a classroom (Driessen, 2002). The other calculated measure was Shannon's diversity index H (Rjosk et al., 2017).

$$H = - \sum_{i=1}^c p_i \ln(p_i)$$

H weights the various countries of origin within a classroom by their relative proportion p_i . Its lower limit is 0. H takes this value when all children in a classroom have the same cultural background. It reaches its maximal value when all children are equally distributed over their c countries of origin (Budescu & Budescu, 2012; Rjosk et al., 2017). Since the number of countries of origin varied between classrooms ($Min = 5$, $Max = 15$), H was additionally normalised (Budescu & Budescu, 2012). This makes the values of H comparable for different numbers of countries c and limits H to a maximum of 1. A higher value of H implies a higher classroom diversity.

$$H_{normal} = \frac{H}{H_{max}} = \frac{-\sum_{i=1}^c p_i \ln(p_i)}{\ln(c)}$$

Control Variables

The analysis additionally included gender, individual immigration background and cultural capital as student level control variables. For the latter measure, the students indicated the number of books they had at home on a five-point Likert scale that was supported by pictures of bookshelves to help them make a more adequate judgement. The mean cultural capital in the sample was $M = 3.68$ ($SD = 1.17$). On a classroom level, school type was included as a dummy-coded variable with the highest school form (*Gymnasium*) as a reference group. The reading strategy intervention from the VESPER study was also included as a classroom-level control variable.

Missing Data

Students with missing information about their cultural origin were not included into the analyses. This was the case for 4.5% of the sample of $N = 1614$. In the multilevel models conducted to answer the first research question, students missing data on predictor variables included in the model were dropped as needed, resulting in final sample size of 1218 students for these models. For the analysis of moderation, classes whose teacher had answered 46 less

than half of the items of the attitude scale were excluded from analyses. This resulted in a sample of 46 classes ($N_{Gymnasium} = 35$, $N_{Realschule} = 7$, $N_{Gemeinschaftsschule} = 4$) with $N = 1140$ students.

Data Analysis

To account for the fact that students in the sample were nested in classrooms, multilevel regressions were used. Reading achievement was group-mean centered due to the relationship with students' placement in classrooms (Dotzel et al., 2020). All other continuous variables were z -standardised at the grand mean.

The first research question was tested by first conducting multilevel models for every diversity measure individually. A second step included the the proportion of minority students as a control in the models for the other two diversity measures to test whether they predicted student achievement beyond the effects of p_{Mig} . To test the moderating effect of teacher attitudes, models were built up stepwise, adding the measure of attitudes and then also including an interaction term between attitude and diversity to the model (Baron & Kenny, 1986).

Results

Descriptive Results

To avoid any issues of multicollinearity, I decided to follow the approach of Rjosk and colleagues (2017) and calculated both $Ncat$ and Shannon's H without including Germany as a country of origin. Thus, both diversity measures describe the diversity of cultural groups within the students with an immigration background. Still, the different diversity measures are highly correlated, as can be seen in Table 1. p_{Mig} and $Ncat$ are positively correlated ($r = .49$, $p < .001$), meaning that in classrooms with a higher proportion of minority students, those students seem to come from a higher number of countries. The correlation of p_{Mig} and Shannon's H is noticeably very large ($r = .97$, $p < .001$), even with the residual calculation of H .

Examining the correlations with the outcome variable reading achievement, both Shannon's H and the proportion of students with an immigration background are negatively correlated with reading achievement at the end of term ($r = -.19$ and $r = -.22$ respectively).

However, the number of cultural backgrounds is not significantly correlated with reading achievement at any point of measurement.

Table 1

Intercorrelations of the main variables included in the models

	RA t_1	RA t_2	Gender	CCap	Background	p_{Mig}	$Ncat$	H_{normal}
RA t_1								
RA t_2	.67***							
Gender	.02 ⁺	.12***						
CCap	.30***	.26***	.02					
Background	-.27***	-.19***	.04 ⁺	-.28***				
p_{Mig}	-.21***	-.19***	.00	-.19***	.32***			
$Ncat$	-.05 ⁺	-.05 ⁺	.00	-.06*	.15***	.49***		
H_{normal}	-.22***	-.20***	.01	-.19***	.31***	.97***	.51***	
VESPER	-.16***	-.11***	-.02	-.07**	.09***	.28***	.41***	.28***
Attitude	-.05	-.09***	.00	-.03	.00	.02	-.02	.05

Notes: RA = reading achievement, CCap = cultural capital, Background = immigration background

⁺ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

With regard to the following analysis, the fact that the reading strategy intervention is significantly correlated with all other classroom level predictors emphasises the importance of including this variable as a control variable.

Effects of Cultural Diversity on Achievement

First, an empty model was calculated, yielding an ICC of .23. This means that 23% of the variance in reading achievement is explained by the nested structure of the data and confirms the necessity of a multilevel approach.

To investigate how cultural diversity affected reading achievement, I first performed random intercept multilevel models for every individual diversity measure. The results can be found in Table 2. When analysed separately, all three diversity measures show negative effects on reading achievement, meaning that after controlling for student and classroom level control

variables, students had lower reading achievements in more diverse classrooms ($\beta_{Ncat} = -.20$, $SE = .04$, $p < .001$; and $\beta_H = -.09$, $SE = .04$, $p < .05$) and classrooms with a higher proportion of minority students ($\beta_{pMig} = -.20$, $SE = .04$, $p < .001$). Gender has a positive regression weight, meaning that girls showed higher reading achievement than boys. Notably, the participation in the reading achievement intervention is not a significant predictor in any of the models. The variance explained by the three models does not differ markedly.

Table 2

Multilevel analyses predicting reading achievement at the end of the school term using individual diversity measures

Variables	Model 1		Model 2		Model 3	
	β	(SE)	β	(SE)	β	(SE)
Intercept	.20**	(.10)	.20 ⁺	(.11)	.19*	(.10)
Student Level						
Gender	.22***	(.05)	.23***	(.04)	.23***	(.05)
Cultural Capital	.05*	(.02)	.05**	(.02)	.05*	(.02)
Immigration Background	.01	(.05)	-.02	(.05)	.01	(.04)
Reading Comprehension t1	.60***	(.08)	.59***	(.02)	.60***	(.02)
Classroom Level						
VESPER	.08	(.08)	-.13	(.09)	-.09	(.07)
Realschule	-.086***	(.10)	-.92***	(.12)	-.85***	(.10)
Gemeinschaftsschule	-1.07***	(.12)	-1.02***	(.14)	-1.03***	(.12)
p_{Mig}	-.20***	(.04)				
$Ncat$			-.09*	(.04)		
Shannon's H_{normal}					-.20***	(.04)
R^2	.47		.44		.46	

Note: VESPER = dichotomous variable coding whether a class participated in the reading strategy training; the marginal R^2 is reported. ⁺ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

The next set of models included the proportion of minority students p_{Mig} in addition to one of the two diversity measures. This way, the models test if cultural diversity explains variance in reading achievement beyond the effects proportion of minority students.

Table 3

Multilevel analyses predicting reading achievement jointly with minority proportion and diversity measures

Variables	Model 1		Model 2	
	β	(SE)	β	(SE)
Intercept	.20*	(.10)	.20*	(.10)
Student Level				
Gender	.23***	(.05)	.23***	(.05)
Cultural Capital	.05*	(.02)	.05*	(.02)
Immigration Background	.01	(.05)	.01	(.05)
Reading Comprehension t1	.60***	(.03)	.60***	(.03)
Classroom Level				
VESPER	-.08	(.08)	-.08	(.08)
Realschule	-0.86***	(.10)	-.86***	(.10)
Gemeinschaftsschule	-1.07***	(.12)	-1.07***	(.12)
p_{Mig}	-.20***	(.04)	-.23	(.15)
$Ncat$	-.01	(.04)		
Shannon's H_{normal}			.03	(.15)
R^2	.47		.47	

Note: VESPER = dichotomous variable coding whether a class participated in the reading strategy training; the marginal R^2 is reported. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

As the results in Table 3 show, the number of origin countries does not add any significant prediction beyond the negative effect of the proportion of minority students. When Shannon's H and minority proportion are included together in one model, however, both effects fail to reach significance. Compared to the previous analyses using individual diversity measures, the standard errors of the β -weights are noticeably larger. This indicates that despite the adjusted calculation of Shannon's H , multicollinearity might have been an issue in this

model (Siegel, 2017). This makes it difficult to interpret whether cultural diversity, as measured by Shannon's H , has any effect on reading achievement beyond p_{Mig} .

Teacher Attitudes as a Moderator

The second research question investigated teachers' attitudes towards cultural diversity as a moderator of the diversity–achievement relationship. To test this, multilevel models including p_{Mig} , diversity measures and the attitude mean–score calculated from Lehmann-Grube's (2017) items were calculated. The models were built stepwise, first including the main effects of the diversity indicator and attitude score and then adding the interaction between the two in a second step. The results are reported in Table 4.

Teacher attitude did not emerge as a significant predictor in any of the models ($\beta = -.04$, $SE = .05$ $p = .481$ in Model 1 and $\beta = -.03$, $SE = .05$, $p = .537$ in Model 3). Accordingly, there is also no significant interaction between diversity measures and teachers' attitude when the interaction of the two variables is added in Models 2 and 4. The hypothesised moderating effect of teachers' attitudes could not be confirmed with this analysis.

Table 5

Multilevel analyses testing the moderating effect of teachers' attitudes in cultural diversity

	Model 1		Model 2		Model 3		Model 4	
Variables	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Intercept	.22 ⁺	(.13)	.19	(.14)	.21 ⁺	(.13)	.18	(.14)
Student Level								
Gender	.21***	(.05)	.22***	(.06)	.21***	(.05)	.22***	(.06)
Cultural Capital	.04 ⁺	(.03)	.05 ⁺	(.03)	.04 ⁺	(.02)	.05 ⁺	(.03)
Immigration Background	.05	(.06)	.03	(.06)	.05	(.06)	.03	(.06)
Reading Comprehension t1	.60***	(.03)	.69	(.03)	.60***	(.03)	.57***	(.03)
Classroom Level								
VESPER	-.11	(.10)	-.14	(.11)	-.10	(.10)	-.14	(.12)
Realschule	-.94***	(.13)	-.94***	(.14)	-.92***	(.13)	-.91***	(.14)
Gemeinschaftsschule	-1.07***	(.17)	-1.07***	(.21)	-1.05***	(.16)	-1.02***	(.20)
p_{Mig}	-.32	(.20)	-.34	(.23)	-.19***	(.05)	-.18**	(.05)
N_{cat}					.00	(.05)	.00	(.06)
Shannon's H_{normal}	.14	(.21)	.16	(.23)				
Teacher Attitude			-.04	(.05)			-.03	(.05)
H_{normal}^* Attitude			.03	(.04)				
N_{cat}^* Attitude							.03	(.05)
R^2	.48		.40		.48		.47	

Note: VESPER = dichotomous variable coding whether a class participated in the reading strategy training; the marginal R^2 is reported. ⁺ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Discussion

Results and Theoretical Implications

The analyses aimed to determine how the cultural diversity of a classroom influences students' reading achievement. Additionally, they wanted to answer the question of whether this effect could be mediated by teachers' attitudes towards diversity.

Regarding the effects of diversity on achievement, the multilevel analyses of the individual diversity measures reveal negative effects for all three measures. This is in line with existing findings. For example, Rjosk and colleagues (2017) also observe negative regression weights, including for Shannon's H , when diversity measures are included in models individually. The negative effect of the proportion of minority students has also been observed in numerous studies (e.g. Mickelson et al., 2020). The more relevant analyses, however, are the models reported in Table 3, which test the effects of diversity measures $Ncat$ and Shannon's H beyond the influence of the minority proportion. For the number of different cultural backgrounds ($Ncat$), this analysis shows that beyond the effect of the proportion of students with an immigration background, the diversity of backgrounds within this group does not have an influence on students' academic achievement.

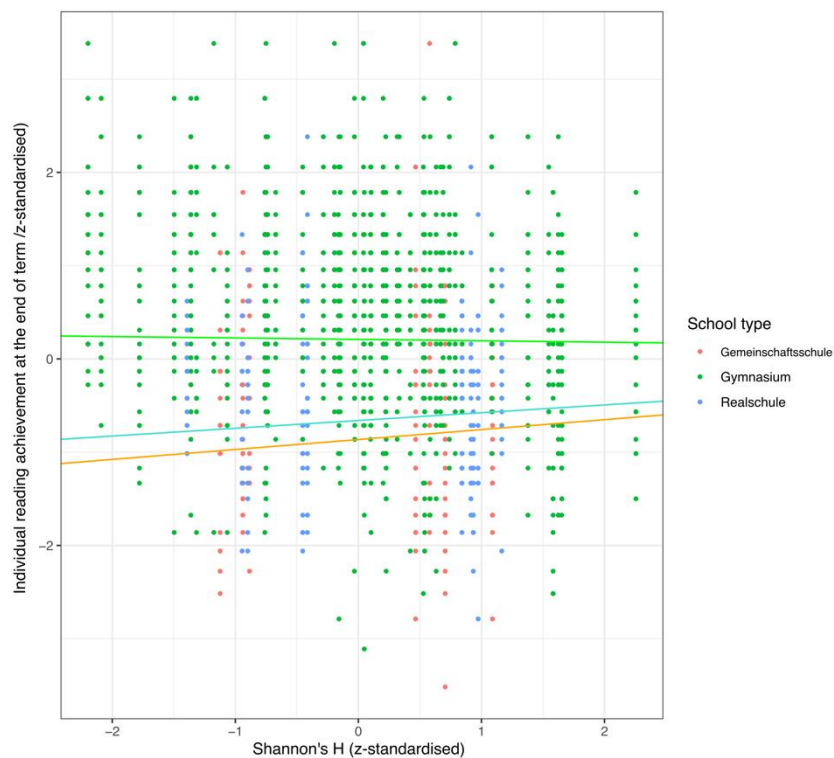
Results are less clearly interpretable for Shannon's H . When both H and p_{Mig} are included in the same model, the previously significant effects of both predictors disappear (see Table 4). At the same time, the standard errors of the regression weights increase strongly ($\beta_H = .03$, $SE = .15$, $p = .867$ and $\beta_{pMig} = -.23$, $SE = .15$, $p = .138$). Combined with the very high correlation of the two predictors ($r = .97$, $p < .001$), this pattern of results could indicate a problem with multicollinearity, even though H was already calculated in a way that should have reduced this. Rjosk and colleagues (2017) encountered similar problems in their paper for the measure of Simpson's D , an index very similar in meaning and calculation to Shannon's H . Both of these measures have increasingly been used to operationalise diversity in recent studies. Should such problems of multicollinearity continue to occur in future research, it might be worth investigating whether other indices of diversity can be used that adequately reflect the variety aspect of diversity while also not correlating as highly with the proportion of minority students. In the supplemental material of their aforementioned 2017 article, Rjosk and

colleagues collect a list of possible diversity indicators that could be tested regarding their correlation with p_{Mig} in future studies.

What stood out in all models analysing the effects of cultural diversity were highly significant effects of the dummy-coded variables for school type. To gain a deeper understanding of the patterns of the effect of cultural diversity, I conducted an exploratory follow-up analysis. In this, I modeled the effect of diversity (Shannon's H) while controlling for the proportion of minority students (p_{Mig}) – analogous to Model 2 in Table 3. To explore the effects of school type, however, the new model allowed for the slopes of Shannon's H to vary across school types. Figure 1 visualises the results of this analysis.

Figure 1

Scatter plot and slopes of the effect of classroom diversity measure Shannon's H on students' reading achievement



It is noticeable that for the two lower school tracks, *Realschule* and *Gemeinschaftsschule*, the slope of the effect of diversity is positive. Only for the highest school track, the *Gymnasium*, the slope is slightly negative, although very close to zero. Since 75% percent of schools in the VESPER sample were *Gymnasien*, this might have contributed to the

lack of a positive relationship between diversity and achievement by masking a positive association within other school tracks.

For future studies on the effects of diversity, school type might be worth investigating beyond its role as a control variable. If reasons for the different slopes of the diversity–achievement relationship could be identified, it may be possible to also achieve such positive slopes at *Gymnasien*, allowing students and teachers of all school types to benefit from cultural diversity. Theoretically, identifying the conditions under which a positive slope of diversity can be found could also extend the understanding of way in which cultural diversity affects student outcomes. Studies conducted in tracked school systems like the German one should also strive to obtain a balanced sample of different school types to avoid overlooking a potentially existing effect due to an unbalanced sample.

The second research question concerned teachers' attitudes towards diversity as a potential moderator of the cultural diversity–achievement relationship. Based on findings indicating positive effects of more positive attitudes on teachers' motivation and willingness to utilise cultural diversity, teacher attitudes were hypothesised to enhance the effect of diversity on achievement in a positive way. However, the moderator analyses could not confirm this assumption (see Table 4). Teachers' attitudes do not significantly predict student achievement. Even in the descriptive analysis that did not take the structure of the data into account, teachers' attitudes only weakly correlated with student achievement ($r = -.09$, $p < .001$). Based on the analyses conducted in this study, teachers' attitudes towards diversity do not affect student achievement, nor do they moderate the effect of cultural diversity.

This study was the first to test this variable as a possible moderator. Based on my findings, teacher attitudes do not seem to be a promising avenue for future research. However, the results of the presented analyses can still inform theoretical considerations on the effects of cultural diversity. Teachers' attitudes were proposed as a possible moderating variable due to their known positive effects on teachers' motivation, enthusiasm and willingness to incorporate students cultural diversity (Gebauer & McElvany, 2020; Hachfeld et al., 2012). Through these positive effects on teachers, attitudes were thought to increase the quality of teaching, which is one of the mechanisms assumed to mediate classroom composition effects, next to peer processes and school resources (Fauth et al., 2021). The assumption when proposing a

moderating effect of teacher attitudes was that the effect of cultural diversity on achievement would be mediated, at least among other factors, through teaching quality. Other theoretical lines of argument have so far mainly expected cultural diversity to affect academic outcomes through peer processes. Given that no empirical support for the moderating effect was found, and in light of other existing arguments for the effects of cultural diversity, one has to question whether teaching quality is a relevant mediator for the effects of cultural diversity. After all, teachers have been shown to adjust their instruction primarily to other more salient dimensions of classroom composition, as has been argued in this very study (Fauth et al., 2021). To summarise, future studies may want to focus on positive effects of cultural diversity mediated through peer processes and explore not only academic but also social outcomes.

Limitations

There are several limitations to this study that should be taken into account when interpreting the results. First, the data in this study was originally collected in the context of an intervention study. 18 of the 46 classes (39%) included in the moderation analysis had conducted a reading strategy training between the two points of measurement. While the intervention did not have a significant impact on students' reading achievement, it might have affected teachers' instruction. As part of the intervention, teachers were required to implement a lesson plan. Teachers in intervention group classrooms thus had less liberty in the planning of their instruction. This should especially be kept in mind with regards to the non-significant moderating effect of teachers' attitudes. The lesson plan might not have given teachers enough leeway for their attitudes to influence their teaching practices. To ensure that the non-significant moderation was not a result of this sample characteristic, I conducted the moderation analyses again on just the control group sample but found no change in the significance pattern of the coefficients.

In addition to stemming from an intervention study, the VESPER dataset has a very high proportion of students with an immigration background, with a high diversity as well – some classrooms included students from up to 15 different countries of origin. It is unclear if a similar pattern of results would have emerged in a more culturally homogenous sample.

Lastly, because this study utilised an existing dataset, no mediators of the effect of diversity could be measured and included in the analyses. This ultimately does not allow for this study to make a final determination on the existence of a direct effect of cultural composition. Even though the reported findings do not suggest the existence of such an effect, a certain judgement cannot be made, especially for the analysis using Shannon's H . It would have been desirable to include measures of instructional quality and particularly of peer processes in the questionnaires and conduct the multilevel analyses with and without the inclusion of these mediators.

Practical Implications

Even though the moderating effect of teachers' attitudes proved to be non-significant, this result can still be helpful in evaluating recent political efforts to improve the handling of cultural diversity in schools. Recent political strategies have strived to increase the number of teachers with an immigration background, anticipating that they should show more positive attitudes towards diversity. Based on this, it is hoped that those teachers may be able to provide a higher instructional quality in classrooms that become increasingly diverse (Gebauer & McElvany, 2020; Syring et al., 2019). Given that this study finds no significant influence of teachers' attitudes on the way diversity affects student outcomes, the ultimate aim of such efforts might have to be reexamined. Teachers with an immigration background can still function as role-models for minority students and may be able to connect to such students especially well. Thus, increasing the representation of diverse cultural backgrounds among teachers remains a valuable goal. If the ultimate goal of such efforts is to improve students' academic outcomes, however, the results of this study indicate that such goals might have to be reevaluated. To increase student achievement, other avenues and other potential moderators should be explored.

Conclusion

Ultimately, this study indicates that the variety of cultural groups in a classroom did not significantly influence student achievement beyond the proportion of minority students. Follow-up analyses did find differences in the effect between school types. Future research should investigate if diversity could have positive effects on student achievement in certain

school types. Teacher attitudes did not emerge as a significant moderator in this relationship. Still, teachers should be adequately prepared for teaching in increasingly diverse classrooms to prevent the perception of cultural diversity as a strain or a problem to be avoided. As for the effects of culturally diverse classrooms in general, future avenues of research could focus on peer-related mediating processes and social outcomes.

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Statutory Declaration

I hereby declare that the paper presented is my own work and that I have not called upon the help of a third party. In addition, I affirm that neither I nor anybody else has submitted this paper or parts of it to obtain credits elsewhere before. I have clearly marked and acknowledged all quotations or references that have been taken from the works of other. All secondary literature and other sources are marked and listed in the bibliography. The same applies to all charts, diagrams and illustrations as well as to all Internet sources. Moreover, I consent to my paper being electronically stored and sent anonymously in order to be checked for plagiarism. I am aware that the paper cannot be evaluated and may be graded “failed” (“nicht ausreichend”) if the declaration is not made.

Heidelberg, May 14th 2021

Merle-Sophie Thielmann