Can School Composition and School Climate Mitigate the Socioeconomic Achievement Gap in Secondary Education?

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Abstract

The academic achievement gap is pervasive and much explored in educational research. Many policies and research have tried to contribute to providing solutions for this type of inequality. This research can complement previous school effectiveness research. It examines the moderating role of school composition and several dimensions of school climate in the relationship between socioeconomic status (SES) and academic achievement. By studying both factors, an attempt is made to provide more insight into the underlying mechanisms. This understanding can be used to develop better educational and social policies to create more educational equality. Fifty-six countries are investigated using data from the Programme for International Student Assessment (PISA) of 2018. A multilevel analysis with three levels, students, schools and countries, is conducted with *SPSS IBM Statistics.* This study finds a positive relationship between SES and academic achievement. In addition, it uncovers that socioeconomic school composition matters, but sociocultural composition does not. In contrast to what was expected, a more favourable socioeconomic school composition favours pupils with higher SES. Furthermore, there is evidence that only the social-emotional safety dimension of school climate moderates the relationship between SES and academic achievement. This moderation does not support the hypothesis as it does not weaken but strengthens the positive relationship between SES and academic achievement. This study has limitations, such as using dummies as a control for countries and lower construct validity. Future research can use this study as a starting point. A longitudinal study with more dimensions of school climate and its interaction with school composition could be interesting.

Keywords: socioeconomic academic achievement gap, school composition, school climate, Programme for International Student Assessment (PISA), multilevel analysis

Can School Composition and School Climate Mitigate the Socioeconomic Achievement Gap in Secondary Education?

Educational research often focuses on reducing inequalities in educational opportunities between different groups (Leavitt & Hess, 2019). Educational inequality is a frequently discussed topic, as it brings significant consequences for the futures of individuals. Within educational inequality, a distinction is often made between inequality of opportunity and outcome (Van de Werfhorst & Mijs, 2010). However, these two dimensions are often intermingled and reinforce each other.

Coleman and colleagues (1966) were among the first who examined academic achievement and identified the strong relationship between student background and academic achievement. Academic achievement is a multifaced construct about students' progress in achieving educational goals. Although more than 50 years have passed since the Coleman Report, the relationship between socioeconomic background and academic achievement is still present and extensive (Berkowitz et al., 2017; Chmielewski, 2019; Thomson, 2018). Inequality in academic performance between students of lower and higher socioeconomic status (SES) is called the socioeconomic academic achievement gap, here abbreviated to the 'achievement gap' (Berkowitz, 2021; Chmielewski, 2019). Students' SES background determines academic performance, implying that not all students get equal educational opportunities (Berkowitz et al., 2017). Parents' economic, cultural and social position matter. With this, students with lower SES backgrounds experience educational disadvantages. This affects not only students' educational careers but also their further careers, societal position, level of life satisfaction, and upward mobility (Chmielewski, 2019; Liu et al., 2022; Montt, 2011). It is argued that education is one of the most influential determinants of an individual's life chances (Baier et al., 2022). Therefore, this kind of inequality can have long-lasting

consequences. It makes that academic achievement is, for example, seen as an indicator of national educational (in)equality (Liu et al., 2022).

Accordingly, narrowing this achievement gap has been the goal ever since (Broer et al., 2019; Leavitt & Hess, 2019). The big question is what can be done about it. In contrast to the early Coleman Report, contemporary research proves that school factors matter in tackling educational inequalities. Schools can help create equal opportunities for all students, regardless of their background (Borman & Dowling, 2010; OECD, 2019c). However, it should be noted that the academic gap is different everywhere but depends on, for instance, social context, welfare systems, or educational systems (Broer et al., 2019; Thomson, 2018). For example, substantial country differences in the size of the achievement gaps can be identified (Thomson, 2018). Many interventions and policies are established in those systems to ensure more equitable opportunities for all students. These can be targeted on different levels, such as individual students, schools, neighbourhoods or national levels, to lower the influence of SES on academic achievement (Broer et al., 2019). Although this issue has been around for a long time, the overarching question remains: which (type of) intervention works and why (Thomson, 2018)? Unfortunately, despite different policies and changes over the years and in various countries, the achievement gap remains persistent (Berkowitz et al., 2017; Hanushek et al., 2019; Hopson et al., 2014; Leavitt & Hess, 2019). Therefore, this research will specifically examine the role of schools in mitigating the achievement gap.

Hence, this study includes two school factors: school composition and school climate. School composition concerns the schools' economic and social bodies (Sykes & Kuyper, 2013). School climate is about the perception of the prevailing school environment in several dimensions (Wang & Degol, 2016). The current study will examine the possible moderating effects of school composition and school climate on the relationship between SES and academic achievement. It is researched using the Programme for International Student

Assessment (PISA) of 2018, which studies over 710.000 15-year-old students from 79 countries (OECD, 2019a). School climate and school composition have both been considered in previous studies (e.g. Berkowitz et al., 2017; Perry & McConney, 2010). This research tests earlier findings in a wide range of countries. Also, this study examines various school climate dimensions from both student and staff perceptions; the latter is not frequently studied (Maxwell et al., 2017).

Additionally, whereas most earlier studies focused mainly on one school factor, this study will consider both factors. Conducting this research will contribute to the existing literature regarding school effectiveness. Broadly speaking, school effectiveness research examines the school or class conditions in relation to academic achievements while keeping the students' backgrounds in mind (Scheerens, 2015). Herein, it is tried to detect the influence of adaptable schooling conditions. An integrated approach is often used, considering the hierarchical layers of the school's functioning (Scheerens, 2015). This study uses an integrated approach because it investigates students' academic outputs, adjusting for their SES background and looking into the (school) context variables.

Besides the fact that there is already some earlier research, it is necessary to keep researching what factors contribute to lessening the effect of SES on students' academic achievement. A better understanding of underlying mechanisms could point to developing better educational and social policies to create more educational equality for all students regardless their SES (Leavitt & Hess, 2019). School composition and school climate are facets of the educational system that could be changed and improve educational equity, thus decreasing the achievement gap (Leavitt & Hess, 2019).

Therefore, his study may offer insights into the underlying mechanisms of the academic achievement gap, which can help policymakers and future research. The following

research question of this study is: *To what extent do school composition and school climate moderate the relationship between socioeconomic status (SES) and academic achievement?*

Theoretical Framework

Socioeconomic Academic Achievement Gap

Disparities in educational opportunities are often studied in educational research, specifically regarding obtaining academic achievements (Leavitt & Hess, 2019). These disparities involve factors such as ethnicity/race, SES or gender. Although SES is widely researched, conceptual meaning still needs to be agreed on (Sirin, 2005). This makes the definition and measurement of SES differ significantly between research (Thomson, 2018). However, the use of parental income, parental education, and parental occupation is often agreed upon as the three leading indicators (S. Li et al., 2020; Sirin, 2005). Students' SES is the strongest individual predictor of academic achievement. A significant relationship exists between SES and academic achievement, to the detriment of lower SES (Berkowitz et al., 2017; Montt, 2011). This academic achievement gap is established in many countries worldwide (Berkowitz et al., 2017). Over the past 50 years, most countries' achievement gap has increased, but differences in the size of the gap between countries can be identified (Chmielewski, 2019; Liu et al., 2022).

The pervasive gap is established, but it remains to be seen how the relationship works precisely. Several explanations are proposed. The social causation model argues that social and economic factors impact children's development and academic achievement (S. Li et al., 2020). Higher SES families have more resources to provide a more stimulating academic home environment (Liu et al., 2022; Sirin, 2005). For example, having more books, educational materials or financial means to invest in learning abilities. Besides financial support, social support is at least as essential for success (Sirin, 2005). For instance, parental

involvement, such as helping with homework, is higher in higher SES families, benefiting achievements (X. Li et al., 2020). Furthermore, higher SES families have better knowledge of education, and higher expectations, resulting in more encouragement and student motivation (Liu et al., 2022; Thomson, 2018). SES's impact starts at a very young age which can have long-lasting consequences. For instance, early SES is related to cognitive stimulation or language development, affecting academic achievements later on (Lurie et al., 2021).

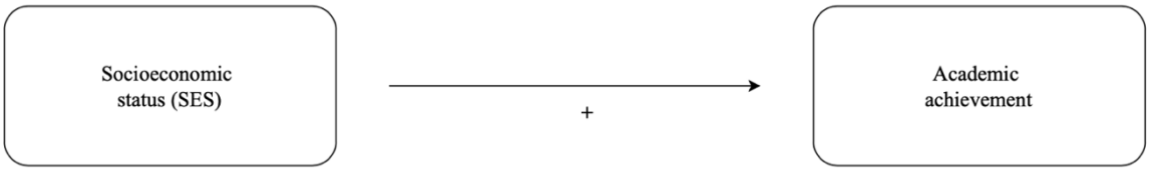
Additionally, SES is also indirectly linked to academic achievement through disparities such as regarding race, health or neighbourhoods (Sirin, 2005). Lower SES tend to experience, for example, more stress or worse adolescent experiences in their neighbourhood, affecting their learning outcomes (Hanushek et al., 2019). Moreover, Liu and colleagues (2022) suggest that higher SES are more often capable of fulfilling their cognitive capacities. However, although genes contribute to academic achievement, it needs to be contextualised too. As Baier and colleagues (2022) argue, utilising the genetic potential for academic performance is often moderated by social conditions. For instance, more genetic potential remains unfulfilled in educational systems with earlier tracking into separate systems (Baier et al., 2022). This is also partly because earlier tracking requires more family investment in making educational choices, to the detriment of lower SES (Van de Werfhorst & Mijs, 2010).

Concluding, the relationship between SES and academic achievement is well established, to the detriment of lower SES (Figure 1). Based on this reasoning, it is expected that:

Hypothesis 1: SES will have a positive relationship with academic achievement.

Figure 1

Model 1 About Hypothesis 1



School Composition

Academic achievement is not entirely determined by students' SES background alone; school context(s) also contribute to students' academic achievement (Berkowitz, 2021; Downey & Condron, 2016; Thomson, 2018). Firstly, school composition is the construction of the school's student body (Sykes & Kuyper, 2013). The school composition partly reflects residential segregation (Gutiérrez et al., 2020). Furthermore, school system characteristics, such as the different ages of tracking and tracks available, determine the school composition (Sykes & Kuyper, 2013). School systems that track at an earlier age tend to be more socially segregated (Gutiérrez et al., 2020). Nowadays, an unequal division of higher and lower SES and disparities regarding ethnicity/racial division between schools can still be found. Income segregation might become increasingly relevant for school composition (Ready & Reid, 2019). This results in school composition being an issue that is high on policymakers' agendas (Gutiérrez et al., 2020; Hopson et al., 2014).

The school composition is mainly divided into socioeconomic and sociocultural composition, the latter referring to ethnicity/race. The socioeconomic composition is also called the (mean) school SES and is about the uneven distribution of students with higher and lower SES backgrounds in schools. The school SES is the average of all attending students (Perry, 2012; Willms, 2010). It is found that the school's SES is a stronger predictor of

academic achievement than the individual's SES (Dronkers et al., 2011; Langenkamp & Carbonaro, 2018; Perry et al., 2022). The effect is positive, wherein a more favourable school SES is related to higher academic achievements (Berkowitz et al., 2015; Perry, 2012). However, the effect size also depends on how SES is measured (Van Ewijk & Sleegers, 2010).

Secondly, the sociocultural dimension reflects the proportion of students with immigrant status. Sizeable ethnic/racial academic achievement gaps exist, resulting in high opportunity inequalities (Hopson et al., 2014). A negative correlation is found between academic achievement and the share of students with an immigrant background (Brandén et al., 2019), even when other important factors, such as school climate or economic factors, were controlled (Hopson et al., 2014). Furthermore, Reardon and colleagues (2019) also stressed the vital link between racial school segregation and more significant academic achievement gaps. However, they found that this gap is wholly operated through school poverty. Meaning the effect of race is insignificant when controlled for a socioeconomic position (Reardon et al., 2019). Racial segregation is problematic, as it clusters low-SES together in what they call high-poverty schools compared to low-poverty schools (Reardon et al., 2019). The disappearance of the effect of sociocultural composition after controlling for socioeconomic composition is also highlighted by Sykes and Kuyper (2013). However, this does not mean that ethnicity or race is now inconsequential, as the (racial) achievement gap partly remains unexplained and the fact that income is also related to ethnicity/race.

Therefore, a lower school SES and a higher proportion of immigrants referred to as having a less favourable school composition, negatively correlate to academic achievement (e.g. Reardon et al., 2019; Sykes & Kuyper, 2013), even when accounting for students' social and economic backgrounds (Ready & Reid, 2019). Nowadays, there is still needs to be a better understanding of the exact impact of school composition on academic achievement

(Borman & Dowling, 2010). Several models come up with an explanation. First, the institutional model argues that resources and opportunities are unequally distributed among schools due to the social contexts (Borman & Dowling, 2010). There is a correlation between school composition and school or classroom contexts, such as the level of school resources, engagement, and time spent together (Willms, 2010; Perry, 2012). All these components affect the student's academic achievement. Also, the composition relates to school and teachers' quality; schools with less favourable compositions have more difficulty finding and keeping well-qualified teachers (Brandén et al., 2019; Goldhaber et al., 2015). Another model is the compositional model, which argues that demographic composition may affect educational outcomes. For instance, the concentration of 'disadvantaged' peers in schools has unfavourable consequences for students' achievement (Brandén et al., 2019). Peers' behaviour affects all schoolmates, impacting the learning environment and the learning outcome. Lastly, the collective socialisation model stresses the importance of social networks and relations in schools, which social capital can help achieve higher academic results (Borman & Dowling, 2010).

These mechanisms attempt to explain the relationship between school composition and students' academic achievement. However, it is still unclear whether and how the effect varies for students (Flannery et al., 2023; Perry & McConney, 2010). Some studies argue that lower SES benefits more, others say that higher SES benefits more, and others argue that the effect is the same for all students (Perry & McConney, 2010). Two frameworks are used for a possible explanation.

On the one hand, the cumulative advantage theory states that higher SES profit more from a more favourable school composition due to its complementing effect. The positive contribution adds up to their own advantages (Langenkamp & Carbonaro, 2018). This is also known as the *Matthew effect*, and its presence is seen as evidence for the widening academic

achievement gap (Huang et al., 2014). On the other hand, the compensatory framework states that lower SES benefit more from a more favourable school composition since these resources provide more value to them, as they do not have much at home (Langenkamp & Carbonaro, 2018). The presence of the compensatory trajectory would reveal the capability of schools to diminish the academic achievement gap (Huang et al., 2014).

Generally, evidence for both the cumulative advantage and compensatory framework has been found in research about school (contexts) in relation to academic achievement, the latter by studies such as those done by Huang and colleagues (2014). However, research often studies primary education, which may differ from secondary education (Neuendorf et al., 2020). Neuendorf and colleagues (2020) showed a compensatory effect in secondary education, indicating that students can catch up during high school.

However, less research specifically examined the role of school composition in the SES academic achievement gap. Although it can be argued that school composition matter for academic achievement, there is still much ambiguity about how this might have differential effects on students (Flannery et al., 2023; Perry et al., 2022). Perry and McConney (2010) found a positive relationship between composition and achievement for all students, regardless of their SES. More recent research (Perry et al., 2022) studied the varying composition effect for high- and low-achievers. This showed that the effect of school composition is big and the same, regardless of achievement. However, it was found that the *relative* effect of school SES is higher for low-achievers (Perry et al., 2022).

Keeping in mind the purpose of school effectiveness research, in which composition is seen as a policy tool to lift lower SES achievement and reduce educational inequality (Armor et al., 2018), this study tests the moderation of school composition on the academic achievement gap. It investigates the extent to which the findings of Huang and colleagues (2014), Neuendorf and colleagues (2020) and Perry and colleagues (2022) can also be

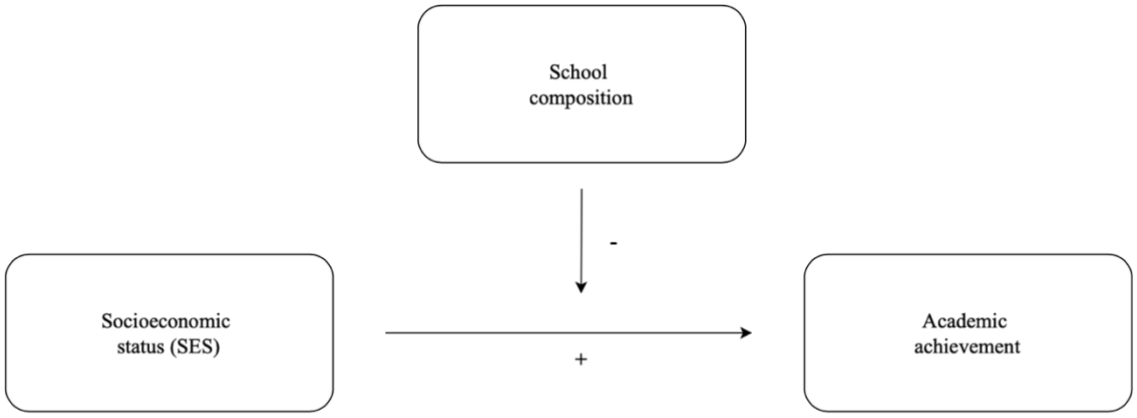
replicated regarding composition and in secondary education. Thus, having the effectiveness goal and the inconclusive frameworks in mind, it will be tested to what extent the SES academic achievement gap will be weaker with a more positive school composition. The following hypotheses are put forward:

Hypothesis 2a: A more favourable socioeconomic school composition will weaken the relationship between SES and academic achievement.

Hypothesis 2b: A more favourable sociocultural school composition will weaken the relationship between SES and academic achievement.

Figure 2

Model 2 About Hypothesis 2a and 2b



School Climate

Besides school composition, school climate is a possible second moderator in the relationship between SES and academic achievement. School climate is often researched, as this is seen as something that can be controlled and, therefore, interesting for policymakers (Maxwell et al., 2017; Teng, 2020). This objective relates to the school effectiveness literature.

School climate is a broad concept that lacks consensus about a single definition and corresponding measurement (Berkowitz et al., 2017; Cohen et al., 2009; Wang & Degol, 2016). The different dimensions highlighted and various measurements, including research levels, complicate the comparisons of studies and underlying mechanisms (Chirkina & Khavenson, 2018; Konold et al., 2018; Thapa et al., 2013).

A starting definition is often referred to the National School Climate Council (NSCC). The NSCC states, "School climate is the quality and character of school life and experiences that reflect norms, values, interpersonal relationships, teaching, learning and leadership practices, and organisational structures" (Berkowitz et al., 2017, p. 430). Various definitions point to a conceptualisation of school climate as the all-encompassing students' perception of school experience(s) (Leavitt & Hess, 2019; Wang & Degol, 2016). School climate is seen as a group phenomenon rather than an individual experience (Cohen et al., 2009). It is subjective and can, broadly speaking, be more or less favourable (OECD, 2019b).

In earlier research, there is a call for a multidimensional conceptualisation of school climate (Maxwell et al., 2017; Wang & Degol, 2016). Some researchers used broad domains, whereas others used more specific indicators. Berkowitz and colleagues (2017) highlight that although no universal definition exists, the supportive and care aspects are crucial in almost all definitions. Albeit different conceptualisations are used, safety, teaching and learning, relationships and environmental-structural are often mentioned (Cohen et al., 2009). Specifically, PISA uses three out of the four dimensions put forward by Wang and Degol (2016). The dimension of academic climate in PISA is called teaching and learning and is about aspects regarding teaching, such as support or curriculum. Community is about school relationships, such as with students, teachers or principals. Safety concerns students' emotional and physical safety (OECD, 2019b). Lastly, PISA did not examine the domain institutional environment.

Schools can increase students' academic achievement compared to what would have been expected based on students' SES background (Berkowitz, 2021). It is consistently found through empirical research conducted worldwide that a more favourable school climate can result in higher academic achievements (e.g. Berkowitz et al., 2017; Teng, 2020; Wang & Degol, 2016). It might be the case that some domains of school climate are stronger related to academic achievement than others (Daily et al., 2019). Although the relationship is quite established, there is still uncertainty about how this relationship exactly works (Konold et al., 2018). Thapa and colleagues (2013) state that a more favourable school climate is related to, among others, more well-being, positive youth development and higher self-esteem, which contribute to higher academic achievement. Also, a well-disciplined environment and less poor student behaviour result in less distraction and more focus on learning (Teng, 2020). Additionally, the more favourable the school climate, the higher the student engagement and students' motivation, which contributes to higher achievements (Cohen et al., 2009; Konold et al., 2018; Kwong & Davis, 2015). Hence, a more favourable school climate is related to a positive learning environment. A school climate can stimulate learning if students feel secure, beloved, supported and stimulated (Cohen et al., 2009).

Accordingly, a more favourable school climate is often related to higher academic achievements and positive behavioural and social outcomes for youth (O'Malley et al., 2015). The research on this phenomenon has been extended to explore whether the climate may counteract or buffer students' exposure to risks at home (O'Malley et al., 2015).

The ecological model stresses the interaction between individuals and others in their environments (Hopson & Lee, 2011; Teng, 2020). The school climate combined with students' backgrounds has a specific effect on academic outcomes (Teng, 2020). More specifically, the risk and resilience model, with risk, promotive and protective factors, is frequently used to explain how school climate might have stronger effects on lower SES

(Hopson & Lee, 2011; Teng, 2020). Risk factors are factors that worsen academic achievement. Promotive factors are factors that increase academic achievement but do not tackle gaps. Protective factors improve especially the achievement of lower SES and therefore contribute to decreasing the achievement gap (Hopson & Lee, 2011; O'Malley et al., 2015; Teng, 2020). A more favourable school climate can be seen as a 'protective' factor, which can either moderate or compensate for the adverse effect of worse background characteristics (Hopson & Lee, 2011; Teng, 2020). The 'moderation model' stresses that climate can buffer against the adverse effects of lower SES. Moreover, the 'compensatory model' stresses whether climate can affect academic achievement beyond the adverse effects (Teng, 2020).

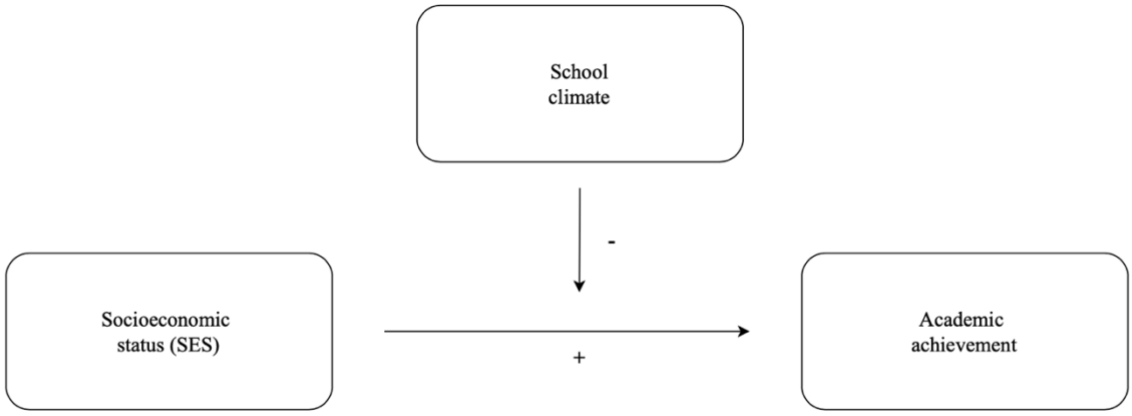
The beneficial impact of a more favourable school climate is particularly applicable to students and schools with a lower SES and disadvantaged background (Berkowitz, 2021, 2022; Berkowitz et al., 2015; Gustafsson et al., 2016; Stienstra et al., 2022). Explicitly, it is tested whether school climate moderates or compensates for the effect of SES on academic achievement. The moderation model was only found at the school-level rather than at the student-level. This point out that schools can reduce the unfavourable effect of SES on academic achievement (Berkowitz, 2021; Berkowitz et al., 2015). Moreover, support for the compensation model was found, resulting that a more favourable school climate indeed improved academic achievement and thus that schools can (slightly) reduce the impact of SES on academic achievements (Berkowitz, 2021, 2022; Berkowitz et al., 2015; Teng, 2020), and thus serve as equalisers of educational inequality (Stienstra et al., 2022).

In conclusion, based on earlier research, a more favourable school climate is expected to be a protective factor that positively affects academic achievement. The effect is found to be stronger for lower SES than for higher SES. Therefore, this research will test whether school climate weakens the relationship between SES and academic achievement (Figure 3). Thus, hypothesis lasts:

Hypothesis 3: A more favourable school climate will weaken the relationship between SES and academic achievement.

Figure 3

Model 3 About Hypothesis 3



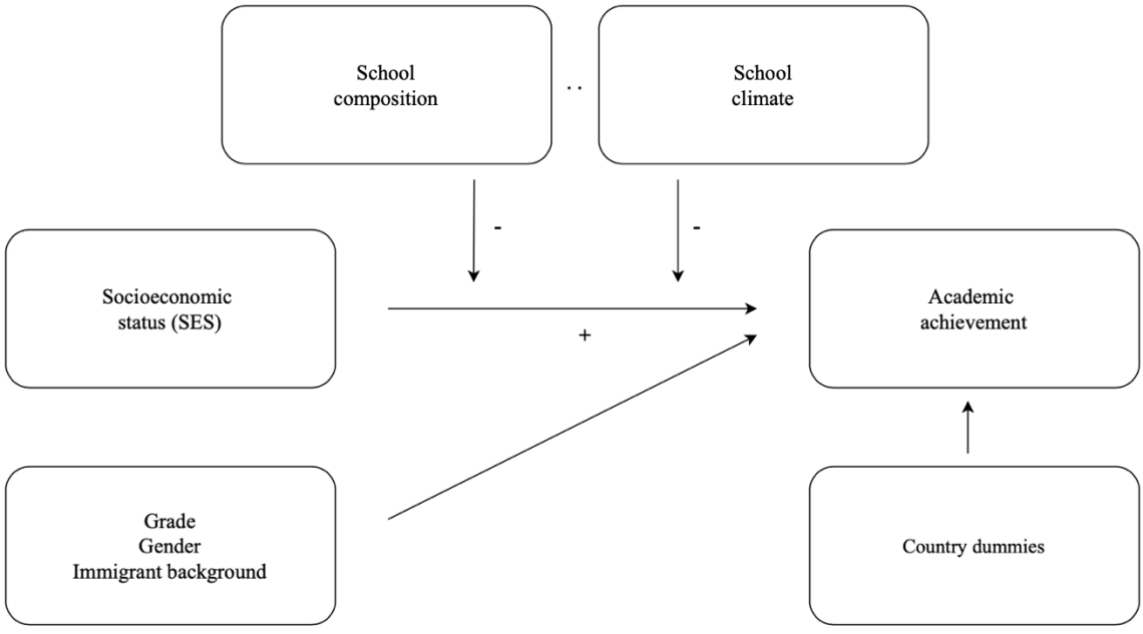
Total Model

In most research, school composition and school climate are studied separately, but it must be considered that school composition and climate are also related. The school composition affects the school climate (Berkowitz et al., 2017; Perry, 2012). School composition shapes the school's student body, which affects the learning environment related to academic achievement (Perry, 2012). For instance, in communities with more poverty or social problems, it is more severe to enhance a more favourable school climate supporting academic achievement (Berkowitz et al., 2015). Moreover, higher SES schools generally have more resources, better support, better teacher-student relationships and fewer disciplinary problems (Perry, 2012). Schools with more resources tend to report more positive school climates than schools with fewer resources (Kwong & Davis, 2015).

This makes school composition and climate interrelated, which means that they must be tested in one model (Figure 4), which gives a more comprehensive answer to the research question. In addition, country dummies are included in the final model to control for variance between countries. The following control variables are added too. First, gender is taken into account because there are differences in academic achievement between females and males (Maxwell et al., 2017; Pamularsih, 2022). Furthermore, the variable grade, the differences in educational level, is a control factor because students' educational level plays a significant role in academic achievement. Lastly, an immigrant background because it is argued that having an immigrant background is significantly related to academic achievement (Broer et al., 2019).

Figure 4

Model 4 About the Total Model, Including Control Variables and Country Dummies



Method

Research Design

A non-experimental quantitative approach is used to study the moderation of school composition and school climate in the relationship between SES and academic achievement. For this purpose, secondary data from the Programme for International Student Assessment (PISA) of 2018 was used. Using an existing dataset is beneficial as it provides high-quality data on a large population. A quantitative method was suitable since it could test hypotheses among large samples in a reliable and repeatable manner. On the other hand, a downside is the limited in-depth investigation of students' perceptions of school composition and school climate (Creswell & Creswell, 2018).

The PISA dataset is a joint effort by the Organisation for Economic Co-operation and Development (OECD) and includes both OECD and non-member countries. Since 2000, every three years, how 15-year-olds score on various educational topics such as mathematics, reading, science, and other cognitive skills are measured together. Additional questions regarding, for instance, students' opinions about well-being and their school are examined (OECD, 2019a). In the wave of 2018, the research population concerned around 710.000 respondents from 79 countries (OECD, 2019a). All participants signed informed consent, and all data is confidential and anonymously published. Moreover, the 'Netherlands Code of Conduct of Research Integrity (VSNU, 2018) is followed as instruction for ethically conducting this research (See Appendix C: Checklist Ethical and Privacy Aspects of Research).

Furthermore, this research concerns a cross-sectional design. Consequently, not all potentially confounding variables and the time sequence can be controlled, making it harder to infer causal relationships (Maggetti et al., 2013). However, as academic achievement does not come before students' SES, it can be argued that SES affects achievement instead of vice

versa. The same applies to school composition and school climate in relation to academic achievement. In addition, one of the key premises of PISA is the allowance for international comparison, above the comparison within countries, such as differences regarding gender or educational levels. However, paying attention to the comparison between countries is essential, as full comparability can only sometimes be guaranteed by PISA (OECD, 2019d). For instance, several biases can play a role: memory decay, social desirability, reference-group bias and response-style bias. Moreover, school climate is subjective and can differ in various contexts. Additionally, some respondents are in a different part of their secondary education, which can make a difference (OECD, 2019b).

Instruments

Several steps had to be taken before the multilevel analysis could be conducted. First, all variables are prepared. For academic achievement and school climate, Principal Component Analyses are conducted. For academic achievement and the subscales of school climate, Cronbach's alphas are used as a reliability analysis to check those scales' internal consistency and reliability. The border values were considered <.70 insufficient, between .70 - .80 as okay, and >.80 as strong (Field, 2017). It is tried to increase Cronbach's alpha by checking 'if item deleted'.

Academic Achievement

The dependent variable is academic achievement. PISA measures the scores of reading, mathematics and science knowledge. However, for this study, only reading (PV1READ to PV10READ) is used because items of the variable school climate concern reading support by teachers. For academic achievement, a Principal Component Analysis has been carried out (KMO = .986, Bartlett's Test of Sphericity = .000) and identified one

dimension (Eigenvalue = 9.443) with strong reliability (α = .993). Generally, the individual averages are computed, and PISA operationalised the academic achievement with an *M* = 500 and *SD* = 100.

Socioeconomic Status

The independent variable is socioeconomic status. In PISA, SES is measured as the combination of the index of Economic, Social and Cultural status (*ESCS*). The measure was derived from three variables; parents' highest obtained educational level (*PARED*, ST005 to ST008), parents' highest occupational level (*HISEI*) and the possessions at home (*HOMEPOS*, ST011 to ST013) (See Appendix A for all statements). These three standardised components weigh equally in the computation of the overall variable *ESCS* (OECD, 2019d).

A Principal Component Analysis confirmed that the subscales *HOMEPOS, HISEI* and *PARED* could be taken together as *ESCS* (KMO = .671, Bartlett's Test of Sphericity = .000, Eigenvalue = 1.887)

School Composition

The literature has shown that schools' socioeconomic and sociocultural composition is distinguished. Only a score for composition and climate is calculated when there are at least 20 pupils in a school. The socioeconomic composition is the average school ESCS, calculated by aggregating students' ESCS (*School ESCS).*

The number of students with an immigrant background measures the sociocultural composition. Immigrant background (*IMMIG*, ST019) is divided into three categories: natives, second-generation and first-generation (OECD, 2019d). A dummy will be computed, with 0 = *native* and 1 = *migrant* (consisting of both second and first-generation). This dummy *Migrant* variable will be aggregated at the school-level (*School proportion migrants*).

School Climate

Based on earlier studies such as those by Wang and Degol (2016), PISA considers safety, teaching and learning, and the school community. PISA expected the following dimensions; Safety is called student disruptive behaviour, covered by the variables bullying (*BEINGBULLIED*, ST038), disciplinary climate (*DISCLIMA*, ST097), and student truancy and lateness (skipping class and being late, ST062). Secondly, teaching and learning, covered by the variables teacher enthusiasm (*TEACHINT*, ST213), teachers' support (*TEACHSUP*, ST100), teacher's adaptivity in instructions (*ADAPTIVITY*, ST212) and teacher's behaviour hindering learning (*TEACHBEHA*, SC061 items 6, 7, 8, 10). Lastly, the school community is expected to be covered by student cooperation and competition (*PERCOMP*, ST205 and *PERCOOP*, ST206) and a sense of belonging (*BELONG*, ST034). Additionally, the variable discriminating school climate (*DISCRIM*, ST223) is added (See Appendix A for all statements). According to PISA, another scale that often depicts school climate is the combination of the variables students hindering learning (*STUBEHA*, SC061 items 1, 2, 3, 4, 5, 11) and teachers hindering learning (*TEACHBEHA*, SC061 items 6, 7, 8, 9, 10). School principals answered these questions and, therefore, are already on the school-level (See Appendix A for statements).

In this research, the dimensions of school climate are explored with factor analyses and compared to PISA's conceptualisation. It is tested if *STUBEHA* could be added to the factor analysis. Eventually, one factor analysis, including *TEACHBEHA* and *STUBEHA* is conducted.

The school climate subscales, created and standardised by PISA, were aggregated at the school-level. This was done to ensure that one overarching factor analysis including school climate variables of the school questionnaire was possible. First, an exploratory Principal Component Analysis with Oblimin rotation was conducted with the variables of

PISA's conceptualisation of school climate factors. Eventually, *STUBEHA* was included in the Principal Component Analysis (KMO = .708 Bartlett's Test of Sphericity = .000), too, because it could form another dimension together with *TEACHBEHA*. The pattern matrix showed that both *Truancy* and *Disciplinary climate* loaded high (> .40) on two factors (See Table B1 in Appendix B). Therefore, it is decided to remove these two subscales. Finally, the following PISA-created subscales were included in the Principal Component Analysis (KMO = .691 Bartlett's Test of Sphericity = .000); Teacher's support and teaching (α = .865), teacher enthusiasm (α = .876), adaptivity (α = .757) being bullied (reversed, α = .885), discrimination (reversed, α = .861), Teacher's behaviour hindering learning (reversed, α = .846), Student's behaviour hindering learning (reversed, α = .874), perceived competition (α = .838), perceived cooperation (α = .915) and belonging (α = .798). The outcome of the factor analysis revealed four dimensions (Eigenvalues were: 2.858, 2.115, 1.513, 1.019 and the cumulative explained variance, respectively 28.6%, 49.7%, 64.9% and 75.1%). The factor loadings can be found in Table 1.

Table 1

Outcomes Factor Analysis of the Questions Related to School Climate

Item	Factor loading			
	1	2	3	4
Teacher's support and teaching				
Teacher enthusiasm	**.930**	-.118	-.006	-.066
Adaptivity	**.872**	.091	.003	.038
Being bullied (R)	**.857**	.029	.004	.078
Discrimination (R)	-.124	**.846**	-.026	.006
Belonging	.111	**.788**	-.007	-.092
Teacher's behaviour hindering learning	.003	**.760**	.057	.073
(R)	-.002	-.063	**.924**	-.051
Student's behaviour hindering learning	-.001	.070	**.882**	.050
(R)	.002	-.205	.004	**.859**
Perceived competition	.071	.232	.008	**.774**
Perceived cooperation				

Note. N = 337069 The extraction method was Principal Component Analysis with an oblique (Oblimin with Kaiser normalization) rotation. Factor loadings above .40 are in bold. Reverse-scored items are denoted with (R).

After the Principal Component Analysis, four factor scores are saved. The names of the factor scores are predominantly determined by items with high (> .40) factor loadings and are tried to be based on the PISA names. The first factor score is called '*Supportive teaching and learning*', and this term is mainly based on the variables *teacher's support and teaching*, *teacher enthusiasm*, and *adaptivity.* The variable *teacher's behaviour hindering learning* is

not included in this dimension. The second factor score is called '*Social-emotional safety*', and this name is notably based on variables *being bullied, discrimination,* and *belonging*. This dimension differs from PISA's expectation, as they expected *being bullied, disciplinary climate and truancy* to go well together. Therefore, another name is used.

The third factor score is called '*Behaviour hindering learning*', and its name is mainly based on *teacher's behaviour hindering learning* and *student's behaviour hindering learning.* PISA did not expect this dimension in their conceptualisation of school climate, but rather these two factors are often used as alternatives for measuring school climate.

Lastly, the fourth saved factor score is called '*School community*', which name followed by *perceived competition* and *perceived cooperation.* This name corresponds to PISA, but *belonging* did not load high as was expected.

Control Variables

Control variables must be carefully considered to ensure only 'good' controls are included. Good controls are variables to eradicate the omitted variable bias (Cinelli et al., 2022). Confounding variables and alternative explanations need to be controlled. Also, including control variables helps to ensure estimating the statistically correct relationships and effect sizes. This research will examine the following control variables.

Firstly, for *gender* (ST004), a dummy will be conducted with 0 = *male* and 1 = *female*.

Secondly, *grade* will be considered as a control variable because there are differences in educational level. Therefore, PISA conducted an index *GRADE* (ST001) to assess between-country variation.

Thirdly, immigrant background (*IMMIG*, ST019) is included as a control variable. A division between native and migrant (first- and second-generation) is made by creating a dummy 0 = *native* and 1 = *migrant* (*Migrant*).

Data Analysis

Assumptions had to be checked before the multilevel analyses could be conducted. For multilevel analysis, the assumptions of linear regression apply (Field, 2017) and are reviewed with statistics, graphs and correlation matrices.

After that, when a participant had one missing value on either one of the research variables, including the control variables, the participant was not included in the final analyses. Additionally, only schools with at least 20 students are included. This is conducted by using a filter.

Following, linear regression is conducted before the multilevel analysis can be performed. A linear relationship between *ESCS* and academic achievement is prerequired. First, a linear regression is carried out between the independent and dependent variables. Secondly, a linear regression with four models, including all study variables, was computed using the enter method. This was used to check the multicollinearity statistics. For the regression analyses, a significance level of $p \leq .05$ is used (Field, 2017).

Finally, multilevel analyses were conducted using *mixed models* after the linear regression and corresponding checks. Before the total conceptual model is tested with both school composition and climate, separate multilevel analyses are computed to test the independent moderating effect for school composition and school climate. For each model, five multilevel models are conducted to test the hypotheses (Figure 4). The country dummies are included as fixed effects in the null model with random intercept. Here, an Intraclass Correlation (ICC), a measure for calculating how significant the contribution of the groups is in the second level, in comparison to the total variance of the whole model (Diez Roux, 2002), is calculated. In the first model, the individual variable *ESCS* and control variables

Grade, *Gender* and *Migrant* are added as fixed effects with random intercepts. In the second model, the second-level variables are further included as fixed effects with random intercept. The third model changes *ESCS* to random effects with a random slope. Based on the literature, *ESCS* may vary across individuals or groups. The random slope makes it possible to vary for heterogeneous effects (Verboon & Peels. 2014). The fourth model includes cross-level interactions between *ESCS* and the school-level variables as fixed effects. The *-2 Log Likelihood* is examined for each model and compared with the previous model to determine whether this model is more explanatory (Verboon & Peels, 2014).

Results

Assumptions

Before the multilevel analyses are conducted, the assumptions are checked. Firstly, the distribution of the independent and dependent variables is normally distributed and therefore satisfies the normality assumption. Secondly, a high correlation (> .65) between the independent variables is not recommended (Field, 2017). This threshold is violated for the correlations between *ESCS*School ESCS* (.675) and *ESCS*IA_ESCS* (-.674). This violation of the assumption makes that results should be interpreted more carefully. In line, multicollinearity is often problematic in multilevel analysis, which can be checked with the collinearity statistics *Variance-inflation factor (VIF)* (max = 10) and *Tolerance* (min = 0.100) (Field, 2017). To prevent this, all predictors are therefore either standardised or centralised (Verboon & Peels, 2014). The results of the *VIF* (range = 1.000–2.820) and *Tolerance* (range = 0.355–1.000) do not exceed the limit values. Thus, there is support for no multicollinearity. Furthermore, there should be enough variance at the second (school) level for multilevel to be appropriate. This is tried to be guaranteed by two separate checks. First, the minimum number of participants in one school is 20. It excludes schools with a too-small subset of participants

to ensure some variance within schools (min = 20, max = 423, *M* = 42.36, *SD* = 37.04). Secondly, the descriptive statistics of the standard deviation (*SD*) are checked. This does not apply to the factor scores of school climate, as those subscales were aggregated before and thus do not have a standard deviation within schools. The standard deviation shows a normally distributed histogram for *School ESCS* (Min. = 0.240, Max. = 1.880, *M* = 0.824, *SD* = 0.182). For *School proportion migrants* (Min. = 0.000, Max. = 0.580, *M* = 0.169, *SD* = 0.167), there is no normal distribution because this category is binary. The standard deviation is crucial for *School ESCS* because the school mean ESCS comprises all the students' ESCS. It is likely that students' individual ESCS also influence what kind of school they attend and, therefore, the school ESCS. As the minimum *ESCS_sd* is 0.240, every school has at least some variance.

Finally, the sample contained *N* = 337069 respondents after removing respondents from schools with less than 20 participating students or with missing values. The descriptive statistics of the study variables can be found in Table 2. The *ESCS* of the selected respondents is slightly below the average of the OECD countries (*M* = -0.411). Moreover, 8.10% of the respondents had a migrant background, and the division of female-male was almost equal.

Table 2

Descriptive Statistics for Study Variables

Variable	Min.	Max.	*M*	*SD*
Individual-level				
Academic achievement	79.250	809.950	451.198	98.625
ESCS	-8.173	3.999	-0.411	1.125
School-level				
School ESCS	-3.510	1.440	-0.412	0.759
School proportion migrants	0.000	1.000	0.081	0.140
Supportive teaching and learning	-4.920	3.622	0.000	1.000
Social-emotional safety	-5.731	3.503	0.000	1.000
Behaviour hindering learning	-3.328	3.021	0.000	1.000
School community	-5.180	4.721	0.000	1.000
Control variables				
Grade	-4.000	3.000	-0.169	0.618
Gender[a]	0.000	1.000	-0.506	0.499
Migrant	0.000	1.000	0.081	0.273

Note. N = 337069. [a] Female = 1.

There is evidence to assume a linear relationship exists between *ESCS* and academic achievement (b = 0.421, SE = 89.437, p =.000). This relation holds when the linear regression was extended with four models. This supports the first hypothesis. After the assumption checks and the linear regression, multilevel analyses were conducted by *mixed models*. The

outcomes of the separate moderation effects for school composition and school climate can be found in Table 3. The results of the final model, with both school composition and school climate, can be found in Table 4.

Table 3

Outcomes Mixed Models School Composition and School Climate (separate) with Dependent Variable Academic Achievement

	Model: School composition					Model: School climate				
	Model 0[a]	Model 1[a]	Model 2[a]	Model 3[a]	Model 4[a]	Model 0[a]	Model 1[a]	Model 2[a]	Model 3[a]	Model 4[a]
	b (SE)	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*
Individual-level fixed effects										
Intercept	508.242***	489.041***	490.245***	489.128***	488.573***	508.242***	489.041***	469.047***	468.013***	466.875***
	(4.218)	(3.597)	(2.976)	(2.990)	(2.962)	(4.218)	(3.597)	(3.014)	(3.027)	(3.019)
ESCS	--	12.252***	10.714***	10.933***	13.823***	--	12.252***	12.106***	12.464***	12.578***
		(0.139)	(0.141)	(0.171)	(0.225)		(0.139)	(0.139)	(0.168)	(0.166)
Gender	--	18.022***	18.052***	17.956***	17.870***	--	18.022***	17.570***	17.455***	17.427***
		(0.252)	(0.251)	(0.251)	(0.251)		(0.252)	(0.252)	(0.251)	(0.251)
Grade	--	32.582***	31.673***	31.651***	31.681***	--	32.582***	31.887***	31.871***	31.854***
		(0.250)	(0.248)	(0.248)	(0.248)		(0.250)	(0.248)	(0.248)	(0.248)
Migrant	--	-5.946***	-6.224***	-5.975***	-5.571***	--	-5.946***	-5.797***	-5.549***	-5.306***
		(0.497)	(0.500)	(0.501)	(0.502)		(0.497)	(0.495)	(0.496)	(0.496)
School-level fixed effects										
School ESCS	--	--	49.147***	49.786***	52.930***	--	--	--	--	--
			(0.630)	(0.639)	(0.643)					

School proportion migrants	--	--	15.130***	15.678***	16.148***	--	--	--	--	--
			(3.410)	(3.417)	(3.445)					
Supportive teaching and	--	--	--	--	--	--	--	-5.184***	-5.270***	-5.464***
learning								(0.454)	(0.455)	(0.460)
Social-emotional safety	--	--	--	--	--	--	--	28.979***	28.843***	30.179***
								(0.484)	(0.482)	(0.492)
Behaviour hindering	--	--	--	--	--	--	--	5.612***	5.516***	5.633***
learning								(0.393)	(0.393)	(0.403)
School community	--	--	--	--	--	--	--	9.876***	9.883***	10.212***
								(0.465)	(0.463)	(0.476)
Cross-level interactions										
ESCS individual *	--	--	--	--	5.411***	--	--	--	--	--
School ESCS					(0.205)					
ESCS individual *	--	--	--	--	0.280	--	--	--	--	--
School proportion migrants					(1.136)					
ESCS individual *	--	--	--	--	--	--	--	--	--	-0.252
Supportive teaching and										(0.174)
learning										
ESCS individual *	--	--	--	--	--	--	--	--	--	2.076***
Social-emotional safety										(0.160)
ESCS individual *	--	--	--	--	--	--	--	--	--	0.386*

Behaviour hindering										(0.168)
learning										0.651***
ESCS individual *	--	--	--	--	--	--	--	--	--	(0.168)
School community										
Random effects										
Variance individual-level	4994.320***	4575.736***	4574.109***	4515.059***	4519.183***	4994.320***	4575.736***	4575.448***	4517.980***	4519.230***
	(12.356)	(11.320)	(11.316)	(11.325)	(11.341)	(12.356)	(11.320)	(11.319)	(11.340)	(11.344)
Variance school-level	2546.666***	1803.472***	1080.856***	1100.315***	1080.455***	2546.666***	1803.472***	1133.848***	1163.068***	1155.442***
	(37.835)	(27.276)	(17.191)	(18.472)	(18.034)	(37.835)	(27.276)	(17.932)	(19.454)	(19.305)
Variance slope	--	--	--	80.856***	61.297***	--	--		78.857***	72.927***
				(3.748)	(3.422)				(3.739)	(3.635)
-2 log-likelihood	3856101.760	3824133.410	3819272.200	3818362.490	3817684.880	3856101.760	3824133.410	3819801.070	3818916.420	3818715.130
Δdf	58	4	2	2	2	58	4	4	2	4

Note. N = 337069. All p values are two-tailed. *p < .05. **p < .01. ***p < .001. [a]Country dummies for 56 countries are included in the analyses as control variables[1].

[1] The included countries are: Albania, Argentina, Australia, Baku (Azerbaijan), Belarus, Bosnia and Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Chile, Chinese Taipei, Colombia, Costa Rica, Croatia, Dominican Republic, Estonia, Germany, Greece, Hong Kong, Hungary, Iceland, Indonesia, Ireland, Italy, Jordan, Kazakhstan, Kosovo, Latvia, Lithuania, Macao, Malaysia, Malta, Mexico, Moldova, Montenegro, Morocco, Moscow Region (RUS), New Zealand, Panama, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Serbia, Slovak Republic, Slovenia, Spain, Switzerland, Tatarstan (RUS), Thailand, Turkey, United Kingdom, Uruguay.
Germany is used as reference category.

Table 4

Outcomes Total Mixed Models School Composition and School Climate (Combined) with Dependent Variable Academic Achievement

	Model: School composition and School climate combined				
	Model 0[a]	Model 1[a]	Model 2[a]	Model 3[a]	Model 4[a]
	b (SE)	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*
Individual-level fixed effects					
Intercept	508.242***	489.041***	474.209***	473.215***	472.405***
	(4.218)	(3.597)	(2.720)	(2.726)	(2.708)
ESCS	--	12.252***	10.729***	10.938***	13.581***
		(0.139)	(0.141)	(0.171)	(0.229)
Gender	--	18.022***	17.627***	17.525***	17.439***
		(0.252)	(0.251)	(0.251)	(0.250)
Grade	--	32.582***	31.152***	31.137***	31.167***
		(0.250)	(0.246)	(0.246)	(0.246)
Migrant	--	-5.946***	-6.269***	-6.021***	-5.617***
		(0.497)	(0.500)	(0.501)	(0.502)

School-level fixed effects					
School ESCS	--	--	36.501***	37.311***	40.230***
			(0.625)	(0.633)	(0.644)
School proportion migrants	--	--	18.625***	19.090***	19.434***
			(3.042)	(3.045)	(3.083)
Supportive teaching and	--	--	-1.582***	-1.629***	-1.702***
learning			(0.399)	(0.400)	(0.402)
Social-emotional safety	--	--	20.870***	20.962***	20.998***
			(0.443)	(0.442)	(0.451)
Behaviour hindering	--	--	2.057***	2.004***	1.624***
learning			(0.347)	(0.346)	(0.354)
School community	--	--	5.124***	5.175***	5.058***
			(0.413)	(0.412)	(0.421)
Cross-level interactions					
ESCS individual *	--	--	--	--	4.951***
School ESCS					(0.229)

ESCS individual *	--	--	--	--	0.423
School proportion migrants					(1.135)
ESCS individual *	--	--	--	--	-0.187
Supportive teaching and learning					(0.174)
ESCS individual *	--	--	--	--	0.504**
Social-emotional safety					(0.170)
ESCS individual *	--	--	--	--	-0.234
Behaviour hindering learning					(0.164)
ESCS individual *	--	--	--	--	0.170
School community					(0.165)
Random effects					
Variance individual-level	4994.320***	4575.736***	4574.290***	4514.985***	4518.392***
	(12.356)	(11.320)	(11.316)	(11.321)	(11.334)

Variance school-level	2546.666***	1803.472***	818.972***	825.744***	815.798***
	(37.835)	(27.276)	(13.533)	(14.549)	(14.269)
Variance slope	--	--	---	81.493***	62.644***
				(3.714)	(3.410)
-2 log-likelihood	3856101.760	3824133.410	3816828.810	3815894.500	3815235.620
Δdf	58	4	6	2	6

Note. N = 337069. All p values are two-tailed. *p < .05. **p < .01. ***p < .001. [a]Country dummies for 56 countries are included in the analyses as control variables[1].

Multilevel Analyses

The outcomes of the three multilevel analyses show the following. Eventually, the combined model is deemed to answer the research question. Therefore, this model is seen as the most explanatory and thus more elaborated on. The null and first model are the same for each model.

The null model examines how much of the variance can be distributed to the second level by differences between schools. Because countries could not be included as another break variable in the analyses, only an Intraclass Correlation (ICC) could be computed for schools. Instead, the models included dummy variables for 56 countries as control variables. The ICC (0.337) indicated that 33.7% of the variance could be attributed to the difference between schools. The ICC is high enough (> 5%) for multilevel analysis. Given the dummies, this percentage is controlled for variance in countries (without the dummy variables, it would have been 48.6%). Most country dummies were significant.

In the first model, the null model has been extended by adding the individual-level fixed effect(s) with a random intercept of *ESCS* and the control variables *Grade, Gender* and *Migrant*. This first model significantly improved over the null model (Δ*-2LL* = 31968.35 Δ*df* = 4). Moreover, it is found that the effect of *ESCS* and the control variables all significantly contribute to the dependent variable academic achievement. The ICC of variance between schools is 28.3%. The percentage ascribed to differences between schools lowers when adding more significant explanatory variables.

In the second model, the school-level variables are included as school-level fixed effects. Next to the individual-level effects, in all the models, the school-level variables *School ESCS, School proportion migrants, Supportive teaching and learning, Social-emotional safety, Behaviour hindering learning* and *School community* are all significant. This means that these level-two variables contribute to explaining the variance in the

dependent variable academic achievement. The second model of the total (combined) model is improved over the first model (Δ-2LL = 7304.60 Δdf = 6).

In the third model, the variable *ESCS* (individual) is added as a random effect meaning that the relationship between *ESCS* and academic achievement can differ for individual students. In the literature, it is shown that academic achievement can vary for *ESCS* and that differences between individuals are often found. In each of the three models, the individual-level and school-level effects remain significant. Also, the school-level variance and the random effect of *ESCS* are significant in all three models. Of the final (combined) model, the third model is significantly improved compared to the second model (Δ-2LL = 934.31 Δdf = 2).

Lastly, the fourth model adds the interaction terms between *ESCS* and the moderators as cross-level interaction fixed effects. In the school composition model, only the interaction effect of *School ESCS* is significant. In the school climate model, the interaction of *Social-emotional safety, Behaviour hindering learning*, and *School community* are significant. In the combined model, only *School ESCS* and *Social-emotional safety* are significant. By adding the school composition to the school climate, fewer dimensions of school climate are significant. Thus, for school climate, only *Social-emotional safety* remains significant and indicates to moderate the socioeconomic academic achievement gap. The fourth model of the combined model is an improvement over the third model (Δ-2LL = 658.88 Δdf = 6). This means that the fourth model is the most explanatory, indicating that the moderating effects add something in explaining the academic achievements of individual students.

Concluding, there is a significant relationship between *ESCS* and academic achievement. This provides support for the first hypothesis. Moreover, a significant cross-level interaction between *ESCS* and *School ESCS* is found. This interaction effect is plotted

(Figure 6).[2] Because the lines diverge, it provides evidence for a significant interaction; academic achievement depends on the school ESCS. A school with a more favourable socioeconomic composition tends to result in higher academic achievement than a school with a less favourable socioeconomic composition. The direction of the interaction is positive (*b* = 4.951), meaning that a higher *ESCS*, in combination with a higher *School ESCS*, results in even higher academic achievement. Therefore, there is no support for approving hypothesis 2a. Furthermore, there is no significant relationship found between the cross-level interaction between *ESCS* and *School proportion migrants*, meaning that there is no support to approve hypothesis 2b. Additionally, the evidence for school climate is mixed. In the school climate model, three out of the four dimensions were significant. When school composition was added, only the *Social-emotional safety* dimension significantly moderated the relationship between *ESCS* and Academic achievement. This interaction effect is plotted (Figure 7)[2]. This graph shows that the lines for low and high *Social-emotional safety* diverge, meaning that the relation between SES and academic achievement is affected by *Social-emotional safety*. The effect of *Social-emotional safety* is positive (*b* = .504), indicating that the combination of higher *ESCS* and higher *Social-emotional safety* leads to higher academic achievement. The relationship between SES and academic achievement is amplified instead of weakened by this school climate dimension. It does not provide support for hypothesis 3.

[2] Dawson (n.d.). 2-way linear interactions [Excel Sheet]. http://www.jeremydawson.co.uk/slopes.htm

Figure 6

Graph of the Interaction Between SES and Socioeconomic Composition

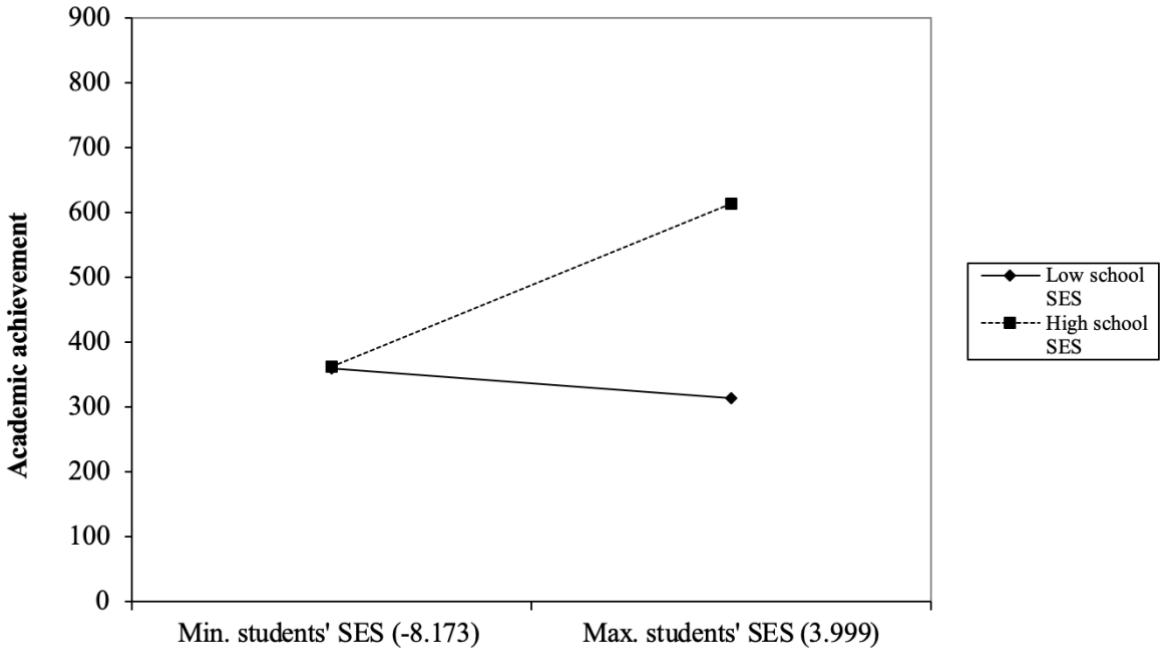
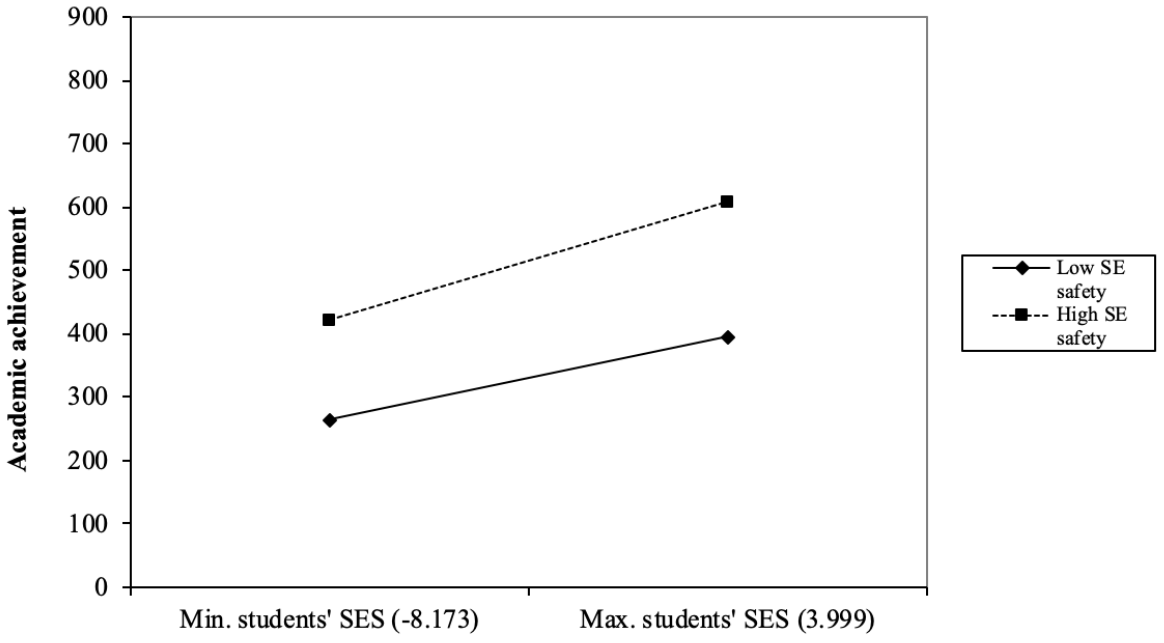


Figure 7

Graph of the Interaction Between SES and Social-emotional Safety (School Climate)



Discussion & Conclusion

The primary purpose of this study was to examine how school composition and school climate can moderate the relationship between SES and academic achievement. The research question is: *To what extent do school composition and school climate moderate the relationship between socioeconomic status (SES) and academic achievement?*

A three-level multilevel analysis was executed to achieve this purpose by considering the data's hierarchical structure. The study of the 56 countries showed that there is indeed evidence for a positive relationship between SES and academic achievement, which supports approving the first hypothesis. It implies that a higher SES background leads to better educational outcomes. This relationship is the socioeconomic academic achievement gap and aligns with previous literature (Berkowitz et al., 2017; Chmielewski, 2019). Nowadays, there is still much educational inequality found all over the world. However, this research cannot pinpoint exactly why the SES background matters, and so – as in previous research – these underlying mechanisms remain pretty unclear.

Furthermore, with an ICC of 33,7%, the multilevel analysis provides evidence that the school-level matters. This percentage of variance explained between schools reduces over the model but remains important. This is in line with contemporary studies (e.g. Berkowitz et al., 2017) and in contrast with the Coleman Report (Coleman et al., 1966).

In the multilevel analyses, socioeconomic school composition is examined. In both the separate and combined models, socioeconomic school composition seems to affect academic achievement. The positive interaction indicates that a student with higher SES in a high SES school benefits, resulting in higher academic achievement. This contrasts hypothesis 2a because it was expected that lower SES would benefit from a higher school SES. Therefore, it cannot be put down that a higher school SES can compensate for one’s student’s SES, as argued in the compensatory framework. This would imply that the achievement gap would

increase, as it provides higher SES instead of lower SES. It should be stressed that this conclusion should be interpreted cautiously, as there is a high correlation between SES and school SES and the interaction term. In addition, a requirement is that there should be enough variance at the second level to avoid making spurious statements. Although attempts were made to achieve this by using a minimum of 20 students within each school and studying the standard deviations, this may have been compromised. For example, it could be the case that there are too few students with lower SES in a higher SES school, making this effect spurious.

Besides the socioeconomic composition, the sociocultural composition was also investigated. Interestingly, this effect is positive, meaning a higher proportion contributes positively to academic achievement. However, no support was established to assume that a more favourable sociocultural composition would affect the relationship between SES and academic achievement (hypothesis 2b). This might be explained by the fact that the migrant group was too small, which might make the possible effect too little. On the other hand, the cultural composition might not matter, which could be due to what is argued by, for instance, Reardon and colleagues (2019) or Sykes and Kuyper (2013); the effect of cultural composition disappears when the socioeconomic composition is also included. These two forms of composition are interrelated, and migrants tend to have lower socioeconomic positions, and thus this might eliminate the sociocultural effect.

Besides composition, school climate was also examined as a possible moderator. This study provides evidence that school climate has several dimensions. This multidimensionality aligns with previous research of, among others, Cohen and colleagues (2009) or Wang and Degol (2016). It is striking that only some of the exact dimensions were found, as argued by PISA. The four identified dimensions are all related to academic achievement. In the separate school climate model, it could be argued that three of the four school climate dimensions change the relationship between SES and academic achievement. When school composition

was included in the model, there was only support that social-emotional safety changed the relationship between SES and academic achievement. The control of composition, therefore, affects which school climate dimension matter in the achievement gap. The positive interaction indicates that the combination of higher ESCS and higher feelings of Social-emotional safety results in higher academic achievements. Therefore, it contributes to enlarging educational inequalities, as a more favourable school composition does not moderate or compensate for the lower SES students. This indicates that the academic achievement gap and underlying inequality will not be diminished. This finding does not correspond to the earlier findings from, among others, Berkowitz (2021) or Teng (2020). An important implication is that disciplinary climate and truancy are removed from the possible related school climate factors. This has implications for the outcomes, as the dimension of the school community (including disciplinary climate and truancy) would have been significant too. However, the decision was made to eliminate truancy and disciplinary climate due to the fact that both items would be high loading on both significant dimensions.

Therefore, both a more favourable school composition and a more favourable school climate could not be seen as a 'protective' factor in the achievement gap. This study shows that school SES and school climate (partly) matter, albeit it is not in the (hoped) direction to reduce inequality. Hereby, a Matthew effect can be noticed; the higher SES profit more from the beneficial socioeconomic school composition or part of the school climate than the lower SES. This aligns with the cumulative (dis)advantage theory; those with a higher SES background can perpetuate or even exacerbate their initial advantages over time, while those with a lower SES background are being held back (Perry et al., 2022).

This research has its limitations. First, before the study, it was expected to do a two-level multilevel analysis. However, as more than 50 countries were still included in the study, it was decided that countries should be added as a third level. Unfortunately, a three-level

multilevel analysis with two break variables could not be performed due to a '*Hessian matrix error*' in SPSS. It was therefore decided to add countries as dummy variables as a solution. By including these dummies, the calculation of the ICC between schools is controlled for country variance. However, it needs to be clarified how much of the variance is attributable to the country-level.

Furthermore, this research used secondary existing data from PISA 2018. Although this dataset is very high quality and has an extensive outreach, it also has its flaws in terms of operationalisation. First of all, the school's economic composition is calculated by the aggregation of individuals' SES. Including both factors in the analysis could result in overestimating the interaction effect. This makes that the result of the moderating effect of ESCS should be interpreted cautiously. Moreover, PISA questioned certain subquestions based on their school climate definition and operationalisation. This limits the current study because it explores certain aspects of school climate to a lesser extent, which results in lower construct validity. This study emphasises the multidimensional character of school climate. However, the found dimensions are not precisely in line with their conceptualisations. For example, the variable *student disruptive behaviour* cannot be classified. Here, a Principal Component Analysis with Oblimin rotation is used, which might not have been ideal for finding the dimensions of PISA. Other research can try to find the PISA dimensions by executing a confirmative factor analysis.

Additionally, this research examined only reading as academic achievement. Although reading was the main focus of PISA 2018, other results could have been found when looking at different dimensions of academic achievement. For instance, it is argued that reading academic achievement might be less affected by school climate than other domains of academic achievement (Maxwell et al., 2017).

Another downside of this study is the use of a non-experimental quantitative approach. This method is limited in quantifying causal relationships due to various limitations. Firstly, in cross-sectional designs, not all confounding variables can be controlled for (Maggetti et al., 2013). Furthermore, it does not specify the direction of the relationship. For example, students with higher academic achievement might perceive their school climate more positively instead of their academic achievement being higher due to their school climate. The latter is also because the time sequence cannot be controlled.

Besides the limitations, this research has shown that school climate is multidimensional and distinguishing those dimensions matter for the learning outcomes. Furthermore, an extensive dataset including 56 countries confirms that SES and academic achievement are related. Also, there is evidence to assume that school SES and a dimension of school climate will not reduce but strengthen the relationship between SES and academic achievement. Interestingly, earlier school effectiveness research focuses mainly on one dimension of school contexts. This research shows that the findings differ for school climate when controlled for school composition. In reality, school composition and school climate will always be part of a school context at the same time. Looking at these effects in isolation could possibly result in overestimating the actual impact.

Thus, this form of educational inequality persists. So, researching these (combination of) factors remains relevant. It is necessary to continue to look at the mechanisms of this relationship and what can contribute to reducing this type of inequality. Future research can take this study as a starting point and continue the study in school climate and school composition. Whether school SES and socio-emotional safety matter in the academic achievement gap and whether the same direction is found, should be examined. Also, more studies should examine the effect of the combination of composition and climate simultaneously. With this, a longitudinal approach would be interesting to explore the

development of the relationship between SES and academic achievement or further (career) outcomes such as income or well-being over a lifetime, as this is only sometimes done (Hanushek et al., 2019). Hereby, student performance over time could be documented, or the effects of interventions can be examined. Another suggestion for follow-up research is to distinguish more dimensions of school climate and explore which dimensions matter more than others to find out what exactly works and what does not. Research could also focus on differences between countries. This study included 56 countries but did not examine their differences. Still, it would be interesting to study how differences manifest per country and whether specific dimensions matter more in one country than others. The extra focus could be on non-Western countries because relatively little research has been done there (Larson et al., 2020). Furthermore, differences between the location of the school and the type of school could be an exciting matter too. For example, an exploratory finding revealed that the school SES might differ between public and private schools. This could be examined in more detail. Finally, a mixed-method study could bring more insight into underlying mechanisms and understanding of school climate experiences. For instance, qualitative insights on student cultures and the influence of interacting with peers are useful to specifically examine the moderating role of school composition and school climate in the achievement gap.

In conclusion, follow-up research can build on these findings. Together this adds to more insights into the socioeconomic academic achievement gap and the mitigation thereof. This will contribute to achieving a more equitable educational system for all.

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Appendix A: Instruments

School composition

ESCS is the factor score of *PARED, HISEI* and *HOMEPOS. PARED* is measured by the questions "What *is the <highest level of schooling> completed by your mother?*" (ST005); "Does *your mother have the following qualifications?* (ST006); "What *is the <highest level of schooling> completed by your father?*" (ST007); "*Does your father have the following qualifications?*" (ST008). Based on the categories for mothers and fathers, an index (*ISCED*) is computed, which is translated to years of education (*PARED*). The parental occupational level is measured with an open question, which is recoded by using the index of international socioeconomic index of occupational status (*ISEI*) and based on that, there is an index calculated for both parents (*HISEI*). Lastly, *HOMEPOS* is measured by the following questions: (ST011) "Which *of the following are in your home -*" – "*a desk to study at*"; "*a room of your own*"; "*a quiet place to study*"; "*a computer you can use for school work*"; "*educational software*"; "*a link to the internet*"; "*classic literature*"; "*books of poetry*"; "*works of art*"; "*books to help with your school work*"; "*<technical reference book>*"; "*a dictionary*"; "*books on art, music or design";* "*<country-specific wealth item 1*"*;* "*<country-specific wealth item 2*"; "*<country-specific wealth item 3*", with answer categories "*yes*" and "*no*". Secondly, "*How many of these are there at your home-*" – "*televisions*"; "*cars*"; "*rooms with a bath or shower*"; "*<cell phones> with internet access*"; "*computers*"; "*tablet computers"; "e-book readers*"; "*musical instruments*", with the following answer categories: "*none*", "*one*", "*two*", "*three or more*" (ST012). And lastly, "How *many books are there in your home?*" with the answer categories "*0-10 books*", "*11-25 books*", "*26-100 books*", "*101-200 books*", "*201-500 books*", "*more than 500 books*" (ST013). These questions are combined in one index *HOMEPOS* (OECD, 2019d).

School climate

The variable school climate consists of multiple items with several statements (OECD, 2019d):

BEINGBULLIED (ST038) is measured by the indication of how often during the past 12 months something happened. The answer categories "*never or almost never*", "*a few times a year*", "*a few times a month*", and "*once a week or more"* were used to measure the following statements: "*Other students left me out of things on purpose*"; "*Other students made fun of me*"; and "*I was threatened by other students*". The items are reversed, such that a higher value contributes to a more favourable school climate.

DISCLIMA (ST097) is measured by how often the statements happened during the lessons. The answer categories were "*every lesson*", "*most lessons*", "*some lessons*", and "*never or hardly ever".* The following statements were asked: "*Students don't listen to what the teacher says*"; "*There is noise and disorder*"; "*The teacher has to wait a long time for students to quiet down*"; "*Students cannot work well*"; and "*Students don't start working for a long time after the lesson begins*". A higher value means a more disciplinary climate, which contributes to a more favourable school climate. Eventually, this subscale is not included in the final factor analysis.

Truancy (ST062) is measured by the question of they had skipped classes, days or arrived late during the past two weeks. The value 0 was given if they did not have skipped or were late and the value 1 was given if they were. The items are reversed, as such that a higher value contributes to a more favourable school climate. Eventually, this subscale is not included in the final factor analysis.

TEACHINT (ST213) is measured with the statements about language-of-instruction lessons. The answer categories "*strongly disagree*", "*disagree*", "*agree*", and "*strongly agree*" were used by the following statements: "*It was clear to me that the teacher liked*

teaching us"; "The enthusiasm of the teacher inspired me"; "*It was clear that the teacher likes to deal with the topic of the lesson*"; and "*The teacher showed enjoyment in teaching*". A higher value means that students perceived their teacher as more enthusiastic, which contributes to a more favourable school climate.

TEACHSUP (ST100) is measured with statements of events in the language-of-instruction lessons. The answer categories were "*never or hardly ever*", "*in some lessons*", "*in most lessons*", and "*in all lessons".* The statements were: "*The teacher shows an interest in every student's learning*"; "*The teacher gives extra help when students need it*"; "*The teacher helps students with their learning*"; and "*The teacher continues teaching until the students understand*". A higher value means that students perceived their teacher as more supportive, which contributes to a more favourable school climate.

ADAPTIVITY (ST212) is measured by how often the following things happened in language-of-instruction lessons. The answer categories were "*never or almost never*", "*some lessons*", "*many lessons*", and "*every lesson or almost every lesson".* The following statements were asked: "*The teacher adapts the lesson to my class's needs and knowledge*"; "*The teacher provides individual help when a student has difficulties understanding a topic or task*"; "*The teacher changes the structure of the lesson on a topic that most students find difficult to understand*". A higher value means that students perceived their teacher to be more adaptive, which contributes to a more favourable school climate.

PERCOMP / PERCOOP (ST205/ST206) measured the competition and cooperation among students. The following answer categories are used: "*not at all true*", "*slightly true*", "*very true*", and "*extremely true*". The statements for *PERCOMP* were: "*Students seem to value competition*"; "*It seems that students are competing with each other*"; and "*Students seem to share the feeling that competing with each other is important*", and for *PERCOOP*: "*Students seem to value co-operation*"; "*It seems that students are co-operating with each*

other"; and "*Students seem to share the feeling that co-operating with each other is important*". A higher value means that students perceived their peers to be either more competitive or cooperative, which contributes to a more favourable school climate.

BELONG (ST034) is measured with statements about their school. The answer categories "*strongly disagree*", "*disagree*", "*agree*", and "*strongly agree*" are used for the following statements: "*I make friends easily at school*"; "*I feel like I belong at school*"; "*I feel awkward and out of place in my school*"; "*Other students seem to like me*"; and "*I feel lonely at school*". A higher value means that students expressed more belonging, which contributes to a more favourable school climate.

DISCRIM (ST223) is about the discriminatory climate and measured with the answer categories "*to none or almost none of them*", "*to some of them*", "*to most of them*", and "*to all or almost all of them*". The statements were: "*They have misconceptions about the history of some cultural groups*"; "*They say negative things about people of some cultural groups*"; "*They blame people of some cultural groups for problems faced by <country of test>*"; and "*They have lower academic expectations for students of some cultural groups*" (OECD, 2019d). The items are reversed, such that a higher value contributes to a more favourable school climate.

STUBEHA and TEACHBEHA (SC061) were measured with the answer categories: "*not at all*", "*very little*", "*to some extent*", and "*a lot*". The statements were "*student truancy*"; "*student skipping classes*"; "*students lacking respect for teachers*"; "*students use alcohol or illegal drugs*"; "*students intimidating or bullying other students*"; "*students not being attentive*"; "*teachers not meeting individual students' needs*"; "*teacher absenteeism*"; "*staff resisting change*"; "*teachers being too strict with students*"; and "*teachers not being well prepared for classes*". The items are reversed, such that a higher value contributes to a more favourable school climate.

Appendix B: Factor Loadings

Table B1

Outcome Factor Analysis of the Questions Related to School Climate, Including Truancy and Disciplinary Climate

Item	Factor loading			
	1	2	3	4
Teacher's support and teaching	**.924**	-.098	.021	-.119
Teacher enthusiasm	**.862**	.100	.016	.052
Adaptivity	**.853**	.028	.008	.101
Disciplinary climate	**.389**	.172	-.091	**.395**
Being bullied (R)	-.069	**.821**	-.018	-.009
Truancy (R)	-.191	**.417**	.035	**.516**
Discrimination (R)	.073	**.800**	-.026	.034
Belonging	.042	**.676**	.094	-.044
Teacher's behaviour hindering learning (R)	.013	-.036	**.917**	-.055
Student's behaviour hindering learning (R)	-.002	.082	**.873**	.088
Perceived competition	.082	-.367	.074	**.713**
Perceived cooperation	.137	.086	.029	**.765**

Note. N = 337069. The extraction method was Principal Component Analysis with an oblique (Oblimin with Kaiser normalization) rotation. Factor loadings above .40 are in bold. Reverse-scored items are denoted with (R).

Appendix C: Checklist ethical and privacy aspects of research

CHECKLIST ETHICAL AND PRIVACY ASPECTS OF RESEARCH

INSTRUCTION

This checklist should be completed for every research study that is conducted at the Department of Public Administration and Sociology (DPAS). This checklist should be completed *before* commencing with data collection or approaching participants. Students can complete this checklist with help of their supervisor.

This checklist is a mandatory part of the empirical master's thesis and has to be uploaded along with the research proposal.

The guideline for ethical aspects of research of the Dutch Sociological Association (NSV) can be found on their website (http://www.nsv-sociologie.nl/?page_id=17). If you have doubts about ethical or privacy aspects of your research study, discuss and resolve the matter with your EUR supervisor. If needed and if advised to do so by your supervisor, you can also consult Dr. Jennifer A. Holland, coordinator of the Sociology Master's Thesis program.

PART I: GENERAL INFORMATION

Project title: School Climate and School Composition as Possible Mitigators of the Achievement Gap: A Moderation Analysis

Name, email of student:	Coco Mooren	669528cm@student.eur.nl
Name, email of supervisor:	Dr. J.F.A. Braster	braster@essb.eur.nl
Start date and duration:	February 13th, 2023 – June 25th, 2023	

Is the research study conducted within DPAS YES - ~~NO~~

If 'NO': at or for what institute or organization will the study be conducted?

(e.g. internship organization)

PART II: HUMAN SUBJECTS

1. Does your research involve human participants. YES - ~~NO~~

   If 'NO': skip to part V.

   If 'YES': does the study involve medical or physical research? ~~YES~~ - NO

   Research that falls under the Medical Research Involving Human Subjects Act (WMO) must first be submitted to an accredited medical research ethics committee or the Central Committee on Research Involving Human Subjects (CCMO).

2. Does your research involve field observations without manipulations that will not involve identification of participants ~~YES~~ - NO

   If 'YES': skip to part IV.

3. Research involving completely anonymous data files (secondary data that has been anonymized by someone else). YES - ~~NO~~

   If 'YES': skip to part IV.

PART III: PARTICIPANTS

1. Will information about the nature of the study and about what participants can expect during the study be withheld from them? YES - NO
2. Will any of the participants not be asked for verbal or written 'informed consent,' whereby they agree to participate in the study? YES - NO
3. Will information about the possibility to discontinue the participation at any time be withheld from participants? YES - NO

4. Will the study involve actively deceiving the participants? YES - NO

Note: almost all research studies involve some kind of deception of participants. Try to think about what types of deception are ethical or non-ethical (e.g. purpose of the study is not told, coercion is exerted on participants, giving participants the feeling that they harm other people by making certain decisions, etc.).

5. Does the study involve the risk of causing psychological stress or negative emotions beyond those normally encountered by participants? ` YES - NO

6. Will information be collected about special categories of data, as defined by the GDPR (e.g. racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, genetic data, biometric data for the purpose of uniquely identifying a person, data concerning mental or physical health, data concerning a person's sex life or sexual orientation)? YES - NO

7. Will the study involve the participation of minors (<18 years old) or other groups that cannot give consent? YES - NO

8. Is the health and/or safety of participants at risk during the study? YES - NO

9. Can participants be identified by the study results or can the confidentiality of the participants' identity not be ensured? YES - NO

10. Are there any other possible ethical issues with regard to this study? YES - NO

If you have answered 'YES' to any of the previous questions, please indicate below why this issue is unavoidable in this study.

_____

_____

_____

_____

What safeguards are taken to relieve possible adverse consequences of these issues (e.g., informing participants about the study afterwards, extra safety regulations, etc.).

_____

_____

_____

_____

Are there any unintended circumstances in the study that can cause harm or have negative (emotional) consequences to the participants? Indicate what possible circumstances this could be.

_____

_____

_____

_____

Please attach your informed consent form in Appendix I, if applicable.

Continue to part IV.

PART IV: SAMPLE

Where will you collect or obtain your data?

The Organisation for Economic Co-operation and Development (OECD) publishes all the Programme for International Student Assessment (PISA) datasets on their website (see https://www.oecd.org/pisa/data/). For this research, data from wave 2018 is used. Specifically, the student questionnaire, teacher questionnaire, and school questionnaire will be used. All the data is completely anonymised by PISA and is freely accessible for everyone.

_____

Note: indicate for separate data sources.

What is the (anticipated) size of your sample?

The total sample of students in PISA 2018 consisted of 710.000 students from 79 countries. For this research, the goal is to compare countries to examine differences between countries as well. Therefore, the whole researched population, around 710.000 students, will be included in this study.

_____

Note: indicate for separate data sources.

What is the size of the population from which you will sample?

The total size of the population includes all 15-year-old-students from the 79 participating countries. PISA sampled around 710.000 students, which is the total population size for this research.

_____

Note: indicate for separate data sources.

Continue to part V.

Part V: Data storage and backup

Where and when will you store your data in the short term, after acquisition?

The databases of PISA wave 2018 will be downloaded from the OECD website separately. In the short-term, these databases will be stored on the researchers' (C. Mooren) own computer.

_____

Note: indicate for separate data sources, for instance for paper-and pencil test data, and for digital data files.

Who is responsible for the immediate day-to-day management, storage and backup of the data arising from your research?

The researcher of this project (C. Mooren) is responsible for the day-to-day management, storage and backup of the data and research.

_____

How (frequently) will you back-up your research data for short-term data security?

The research data and analyses will be backed up every week.

_____

In case of collecting personal data how will you anonymize the data?

In this research, secondary data is used and thus the data has been anonymised by the PISA/OECD already. There will be no personal data collection in this research and therefore, this does not further apply.

Note: It is advisable to keep directly identifying personal details separated from the rest of the data. Personal details are then replaced by a key/ code. Only the code is part of the database with data and the list of respondents/research subjects is kept separate.

PART VI: SIGNATURE

Please note that it is your responsibility to follow the ethical guidelines in the conduct of your study. This includes providing information to participants about the study and ensuring confidentiality in storage and use of personal data. Treat participants respectfully, be on time at appointments, call participants when they have signed up for your study and fulfil promises made to participants.

Furthermore, it is your responsibility that data are authentic, of high quality and properly stored. The principle is always that the supervisor (or strictly speaking the Erasmus University Rotterdam) remains owner of the data, and that the student should therefore hand over all data to the supervisor.

Hereby I declare that the study will be conducted in accordance with the ethical guidelines of the Department of Public Administration and Sociology at Erasmus University Rotterdam. I have answered the questions truthfully.

Name student:	Name (EUR) supervisor:
Coco Mooren	Dr. J.F.A. Braster
Date: 25/3/2023	Date: 25/3/2023

Appendix D: Syntax

This research's syntax can be obtained through the following link: https://docs.google.com/document/d/1LBmyLaxY5ncjh66voWXD4G6Mw6Bz9TF6jO7oS4hm8QA/edit?usp=sharing