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Does the material well-being at schools successfully compensate for socioeconomic disadvantages? Analysis of resilient schools in Sweden

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Abstract

Background: A variety of studies point to a deterioration of educational equity in Sweden and increasing school segregation with respect to achievement and socioeconomic composition. Some schools are resilient to socioeconomic disadvantages in their student body and demonstrate high levels of achievement. However, little attention has been given to these resilient schools. Material well-being, as one important dimension of student well-being, comprises the student's home background and school resources. The relationship between home background and achievement is well-established but less literature includes school-level factors of material well-being. In comparing the material well-being at resilient, non-resilient, and more advantaged schools, this study aims at detecting possible patterns that may provide crucial information as to why some schools succeed better in compensating for disadvantages.

Methods: Using Swedish data from the Programme for International Student Assessment (PISA) from 2000 to 2018, the shares of resilient, non-resilient, and more advantaged school groups with different achievement levels were identified by using aggregated achievement and socioeconomic background measures. Making use of a well-being framework specifically designed for PISA data, the school groups were compared regarding their material well-being as measured by the perceived shortage of material resources and teachers, the percentage of teachers fully certified, the availability of computers, and extracurricular activities. This comparison of school groups was computed using the nonparametric Kruskal-Wallis test and a Bonferroni-adjusted pairwise comparison.

Results: The shares of resilient schools decreased considerably from 14% in 2000 to 3% in 2015. Yet, the comparison of the material well-being at resilient and other school groups led to mostly non-significant results. Overall, disadvantaged schools reported higher teacher shortages than advantaged schools, which indicates the need for a more compensatory allocation of (human) resources.

Conclusions: The study concluded that the landscape of resilient schools is under continuous change. As no patterns of significant differences between resilient and other school groups were found, the study shows no indication that the material

well-being at school compensates for disadvantages in a school's student body. The findings call for further research regarding changes in the presence of resilient schools and their possible relationship with school material well-being.

Keywords: Academic resilience, Resilient schools, Material well-being, Educational equity

Introduction

Educational equity and schools' mission to compensate for differences in student composition is at the center of Swedish school policy. Chapter 1 of the Swedish Education Act states that education in the school system should be equal, regardless of the type of school and where in the country it is organized. The school system should provide support developing all students' learning opportunities and should aim to compensate for differences in students' background characteristics and academic ability (The Swedish Code of Statutes [SFS], 2010:800, Chapter 1, §4). This responsibility of the education system to compensate for students' different background characteristics is hereafter referred to as the school's compensatory mission. In an equitable education system, students' home background and their achievement should be unrelated.

Nevertheless, it could be argued that Sweden, which once had the reputation of having one of the most equal school systems in the world, can no longer be seen as such. Rather, recent studies have drawn the picture of a school system with increasing inequity and a compensatory mission that is lacking. Results from international large-scale assessments show clear socioeconomic disparities in student outcomes in Sweden. As of the latest PISA study (Programme of International Student Assessment, initiated by the Organisation for Economic Co-operation and Development [OECD]) in 2018, the achievement gap between socioeconomically advantaged and disadvantaged students was similar to the OECD average (Avvisati et al., 2019) and equivalent to about 3 years of schooling (OECD, 2018). Overall, 13% of the variation in mathematics and science performance could be explained by the students' socioeconomic status in 2018 (Avvisati et al., 2019).

Yet, the relationship between students' socioeconomic background and achievement, which can be seen as one of the main indicators of inequity, has not always been this strong. Studies have shown a distinct strengthening of this relationship between 1998 and 2014 (Gustafsson & Yang Hansen, 2018; Yang Hansen & Gustafsson, 2019). Additionally, an increase in school segregation with respect to educational achievement has been reported (Swedish National Agency for Education [Skolverket], 2009; Yang Hansen & Gustafsson, 2016). According to Yang Hansen and Gustafsson (2019), who conducted a variety of studies on this issue, there is reason "to believe that the organizational changes in [the] Swedish education system in the past decades have influenced educational equity negatively" (p.81).

What Yang Hansen and Gustafsson (2019) are referring to are major policy reforms that the Swedish education system underwent in the 1990s and which Skolverket would later refer to as "the beginning of a system change for the school" (Skolverket, 2009, p. 14, translated by the authors). Helgøy (2006) describes this period as one which fundamentally changed the institutions in place due to sudden, radical decisions and confrontationally implemented changes, characterized by "conversion" (Helgøy, 2006, p. 108). Until the early 1990s, principals and teachers were employed by the state and their

wages and working conditions were regulated centrally. Decentralization reforms of the education system in the late 1980s and early 1990s transferred the responsibility for hiring and paying principals and teachers from the state level to the local level, that is, to the municipalities (Jarl et al. 2012). The responsibility for organizing public education and for allocating resources to schools was also decentralized to the municipalities, and detailed state regulation was replaced by management by objectives and results. In doing so, the government decided on a national curriculum that identifies the overall objectives of schooling but transferred the responsibility for the organization and implementation to the municipalities and school principals (Lindberg & Wilson, 2011). The decentralization reforms thus increased the autonomy of principals who were entrusted the mandate to decide on schools' internal organization (SFS, 2010:800). Furthermore, the introduction of a voucher system at the beginning of the 1990s paved the way for an expansion of independent schools, as students and parents were given the opportunity to choose a tuition-free school of their preference, whether municipal or independent, and state funds and resources followed the students. Previous studies have argued that the decentralization and marketization reforms of the early 1990s transformed Swedish education from one of the most centralized and detailed regulated educational systems in the Western world to one of the most decentralized (Lundahl, 2002, 2005).

While it is important to note that we cannot make definite claims about causality, achievement differences between schools have increased since the implementation of the reforms. Skolverket believes the school choice reform and decentralization have likely contributed to the increasing variation in quality and achievement (Skolverket, 2012). The student composition of schools has become increasingly homogenous, with students with similar socioeconomic or migration backgrounds gathering at the same schools (Skolverket, 2009). According to a Swedish Government Official Report (Statens offentliga utredningar [SOU] 2019:40, p. 149), the school itself explained only about 4% of the variation in students' grades in year nine in the 1990s, 7% in 2000, and around 14% in 2014. Although factors related to the school itself explain less of the variation when taking the student composition into account, the report concludes that there are quality differences between schools that need to be further addressed in research (SOU 2019:40).

Despite the increasing inequity and troubling correlation between socioeconomic background and achievement, some individual students manage to "beat the odds" and achieve high despite having a socioeconomically disadvantaged background. These students are commonly referred to as academically resilient students (e.g., Agasisti et al., 2018; Martin, 2013; Martin & Marsh, 2006). While previous research often focuses on the individual characteristics of academically resilient students (Agasisti & Longobardi, 2016), this study shifts the focus to what we will refer to as *resilient schools*, which demonstrate relatively high levels of average student achievement despite having a socioeconomically challenged student body. This is an approach that has been applied more seldom in existing literature (e.g., Drossel et al., 2020) but that bears the opportunity to analyze patterns of successful schools. Such analyses may provide information that is essential for closing gaps and moving towards educational equity.

As discussed earlier, results from PISA and other studies indicate that the socioeconomic background of a student is strongly related to their achievement (see Sirin,

2005 for a meta-analytic review). Borgonovi (2020) referred to this as a strong association between the material well-being (i.e., the socioeconomic background) and cognitive well-being (i.e., achievement) of a student. While the material well-being of the student body may explain parts of the variation in achievement outcomes between schools, we widen the scope for this study and explore additional aspects on a school level. Borgonovi and Pál (2016), whose framework is used in this study, argued that the material dimension of well-being is more than simply the students' family background but should also include measures on a school level, such as the human and material resources at school.

Agasisti and Longobardi (2016), who analyzed the characteristics of schools attended by resilient students (i.e., a slightly different approach than the present study) from different OECD countries, found that schools with more resilient students were richer in resources. The availability of such resources for resilient and non-resilient schools in Sweden is currently underexplored but could provide important indications as to why some schools more successfully compensate for disadvantages in their student body than others. Therefore, the overarching question of this study is: Does the material well-being at school successfully compensate for socioeconomic disadvantages? The focus is set on the special group of resilient schools that successfully compensate for the socioeconomic disadvantage of their students. In comparing successful and failing schools, theoretical understandings of the mechanism behind school success can be developed (Jarl et al. 2017). Following this line of reasoning, this study defines and compares different groups of schools, one of which is a group of resilient schools. With a quantitative analysis of differences between high- and low-achieving schools with different socioeconomic student compositions, we aim to contribute to a better understanding of the role of schools' material well-being in the schools' compensatory mission. By including data from the past two decades, not only can differences in resources between school groups be analyzed, but also whether these differences are constant over time. This may be especially interesting in light of the issues of deteriorating educational equity that Sweden currently faces (e.g., Skolverket, 2006; Yang Hansen & Gustafsson, 2019) but could also inform future research in other Nordic countries which share certain similarities with the Swedish system. If we identify resilient schools in Sweden and find indications that their level of material well-being is greater than at non-resilient schools, we are one step closer to understanding the school's role in compensating for socioeconomic differences in their student body. With a deeper understanding of the differences between resilient, non-resilient, and more advantaged schools, a more effective and equitable distribution of resources can be developed. Against this background, the study poses the following research questions:

1. Can resilient schools be identified in Sweden, and are there changes in the number of resilient schools throughout PISA cycles from 2000 to 2018?
2. How do resilient schools compare to non-resilient and more advantaged schools regarding their material well-being?

Framework for the analysis of material well-being

The study makes use of a framework by Borgonovi & Pál (2016), who, in accordance with other literature (e.g., Colombo, 1984), stated that well-being is a multidimensional construct. These dimensions are psychological, social, cognitive, physical, and material. The first four dimensions are not a focus in this paper for two reasons: they are mainly measured using self-reported data on the students' individual level, and prior PISA assessments lack important information because the framework was first introduced in PISA 2015. The material dimension of well-being, on the other hand, has been regularly measured both by individual factors within the student's household environment and by school-level factors obtained in a principal questionnaire (see Fig. 1), which allows for an in-depth comparison of schools in all cycles.

Existing literature indicates that the household environment of a student plays an important part in providing students with better chances to achieve high at school (Sirin, 2005). This points to the relationship between the material and cognitive well-being of students. In this study, the students' household environment is included in the classification of resilient schools as they have, per chosen definition, a socioeconomically disadvantaged student body (Agasisti et al., 2018). As it is the school's responsibility to compensate for differences in the student's background, we include school-level aspects of the material dimension of well-being to see whether they differ between successful schools and those with less favorable outcomes.

According to the chosen framework, human resources at school are one major pillar of the material dimension of well-being and can be measured by teacher shortage and teacher profile. Including the perceived lack of qualified staff and the proportion of fully certified teachers (i.e., teacher profile) in the framework supports the idea that good teacher qualifications are associated with higher student achievement. Here, Borgonovi and Pál (2016) referred to a study by Akiba et al. (2007) who found that countries with better teacher quality demonstrated significantly higher academic achievement.

Material resources at school are measured by physical educational resources and computer availability. The effect of school resources on student achievement has been an ongoing debate and no clear consensus has been met. While some studies have concluded that resource inputs do not particularly matter for student outcomes (Wößmann, 2003), others have highlighted the importance of increasing spending on school resources to increase student achievement (Greenwald et al., 1996).

Lastly, extracurricular activities are included in the measure of material well-being. Schools need "financial, infrastructural, human and time resources in order to provide high quality extracurricular programs" (Borgonovi & Pál, 2016, p. 46). While advantaged students may be able to seek activities outside of schools, extracurricular activities at school can be a way to compensate for socioeconomic differences and offer high-quality activities for all students, no matter their financial background. Borgonovi and Pál (2016) referred to existing literature that argues that participation in extracurricular activities can create a positive connection to the school, promote higher academic performance, and lower dropout rates, especially for at-risk students (Mahoney & Cairns, 1997).

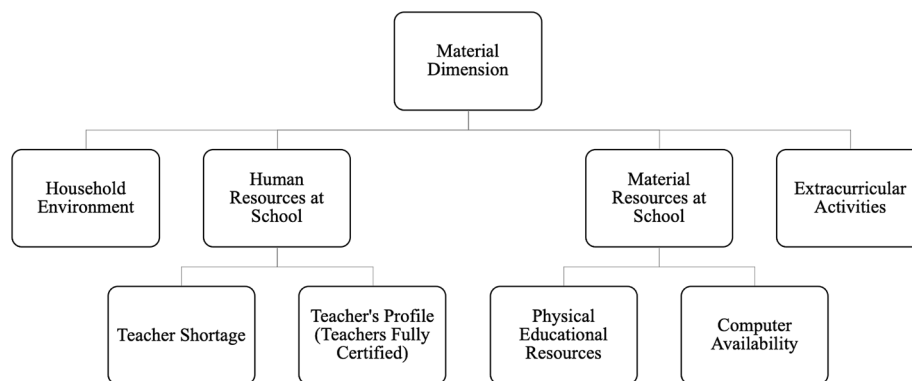


Fig. 1 Material Dimension of Well-Being. Adapted from “A Framework for the Analysis of Student Well-Being in the PISA 2015 Study: Being 15 in 2015”, by F. Borgonovi & J. Pál, 2016, OECD Education Working Papers, p.38

Method

Data and sampling

The study makes use of data from PISA, which is an international large-scale assessment initiated by the OECD. Every three years, starting in 2000, 15-year-old students from numerous economies worldwide are asked to complete surveys and complex ability tests on reading, mathematics, and science literacy, with one of the three subjects being declared the major test domain each cycle. The data, which are openly available online, include the students’ achievement as measured by PISA, as well as information about their background, school life, and well-being. Data are collected through various surveys addressed to the student, their guardians, teachers, and the school’s principal. To closely mirror the population of students, the OECD uses a two-stage stratified sample design. The first stage consists of systematically sampling schools that are defined as PISA-eligible schools, and in the second stage, 15-year-old students within those schools are randomly selected (OECD, 2017).

The present study includes Swedish data from all seven cycles of PISA to allow for an analysis of potential patterns emerging over time. Table 1 shows the sample size of participating students and schools. As 15-year-old students were sampled in PISA, the majority of students were in Grade 9 at lower secondary school at the point of testing, while a minority of students were in Grade 7 or 8 at said schools or in Grade 10 at upper secondary school. Given that this study considers the school level, non-ninth-grade students were excluded from the analysis to reduce bias, as the length of study may have influenced achievement scores. Thus, schools without ninth graders and schools with missing information on their students’ socioeconomic disposition or achievement were excluded.

Variables

Resilient schools are defined as those that demonstrate high achievement despite having a socioeconomically disadvantaged student body. To operationally define this and other school groups, the variables indicating a student’s socioeconomic background and achievement, measured at the individual student level, were used and aggregated to a school mean. For the schools’ socioeconomic composition, the school-level

Table 1 Summary of sample sizes (n), included and excluded data for each cycle

	2000	2003	2006	2009	2012	2015	2018	Total
Students	4 416	4 624	4 443	4 567	4 736	5 458	5 504	33 748
Included	4 278	4 420	4 264	4 357	4 496	5 244	5 332	32 393
Excluded (%)	138 (3.13%)	204 (4.41%)	179 (4.03%)	210 (4.60%)	240 (5.07%)	214 (3.92%)	172 (3.13%)	1 355 (4.02%)
Schools	154	185	197	189	209	202	223	1 359
Included	152	172	176	176	184	190	206	1 256
Excluded (%)	2 (1.30%)	13 (7.03%)	21 (10.66%)	13 (6.88%)	25 (11.96%)	12 (5.94%)	17 (7.62%)	103 (7.58%)

aggregation of the students' index of economic, social, and cultural status (ESCS) was used. This index is a composite measure that is closely related to the socioeconomic status and can be defined as "a measure of students' access to family resources (financial capital, social capital, cultural capital and human capital) which determine the social position of the student's family/household" (Avvisati, 2020, p. 3). The index is derived from a set of three indices within the student self-reported background questionnaire: parental education and occupation and household possessions, such as having one's own room, and access to the internet or books at home. These household possessions, which are partly country-specific, are then taken as proxies for the family's cultural capital and wealth (Avvisati, 2020; OECD, 2019a). The index is scaled so that a score of zero reflects the ESCS of an average OECD student (OECD, 2019a). With the application of specific boundaries (see "Analytical Strategy" below), this study uses the ESCS index to define and compare different socioeconomic profiles.

The schools' mean achievement in all three subjects was measured by the schools' aggregated test results in PISA. For this, the first plausible value of mathematics, science, and reading was used. Once aggregated to the school level, the mean school achievement in each subject was translated into proficiency levels that are predefined by PISA (for more detailed information about the operationalization of school groups, see "Analytical Strategy" below). Proficiency levels are used to "describe what students *typically* know and can do at given levels of proficiency" (OECD, 2017, p. 276) and correspond to items of varying difficulty. Each successive level corresponds to increasing difficulty of tasks, and students placed at the lower boundary of a given level are expected to correctly complete at least half of the task on a test set at that level of difficulty. According to Agasisti et al. (2018), the proficiency Level 3 reflects positive academic adaptation as this is the median proficiency level in PISA, which is the highest level reached by at least 50% of students across OECD countries on average. At this level, students are typically capable of solving tasks of moderate complexity. Due to its absolute threshold, this operationalization of positive adaptation is robust in trend comparisons. Further, the use of Level 3 as a cutoff is underpinned by the idea that resilient students should demonstrate achievement that is consistent with developmental task expectations and should be comparable to, or even better than, the majority of students (for an overview of different operationalizations of academic resilience, see, e.g., Rudd et al., 2021; Ye et al., 2021).

All three domains are included in the definition of academic resilience, as they are seen to reflect essential capabilities needed for future success (Agasisti et al., 2018).

The school groups are compared according to the aspects of their material well-being as described in the framework by Borgonovi and Pál (2016), namely the perceived teacher shortage and proportion of fully certified teachers, physical educational resources, the availability of computers, and extracurricular activities. Tables 2 and 3 show these variables, which are derived from the school principal questionnaire, and illustrate how indicators have changed throughout the years. The study makes use of PISA school-level indices to measure shortages of teachers and material resources. Such indices are constructed through scaling multiple items (which can be derived from Table 2) using a two-parameter item-response model (OECD, 2019b, OECD, 2016). The values correspond to Warm likelihood estimates (Warm, 1989) and are scaled so that zero represents the OECD mean, while positive values indicate that school principals noted higher exposure to shortages than the OECD average (OECD, 2016). The variable indicating the teacher's profile refers to the percentage of certified teachers per school. The computer availability is expressed as a ratio of the number of computers available and the school enrollment size (for slight differences across cycles, please see Table 2), and scores for extracurricular activities directly refer to the number of selected activities offered at schools.

Analytical strategy

At the individual level, academically resilient students have often been defined as those who achieve high despite experiencing adversity, such as a low socioeconomic background, that places them at risk of underachievement (e.g., Agasisti et al., 2018; Martin & Marsh, 2006; OECD, 2018). According to Agasisti and colleagues (2018), resilient students can be defined as those who fall within the bottom 25th percentile of their country's socioeconomic distribution and achieve at or above proficiency Level 3 in the PISA subjects reading, mathematics, and science; a level in which students are said to be equipped "for success later in life" (Agasisti et al., 2018, p. 8). For the present study, this operationalization was applied to the school context. Schools are considered socioeconomically disadvantaged if their students' mean value in the ESCS index falls within the bottom 25% of the Swedish school's ESCS distribution. Schools within the middle 50% of the distribution are classified as having an average socioeconomic background, and schools that fall in the top 25% of the distribution are considered socioeconomically advantaged within Sweden. To adapt to changes in the distribution across cycles, the ESCS cutoff values are defined separately for each cycle.

For the aggregated student achievement, the first plausible values of mathematics, science, and reading achievement were used.¹ The individual student data for each domain was separately aggregated to the school mean. Once aggregated to the school level, the mean school achievement in each subject was separately translated into proficiency levels. Proficiency levels, while not included in the initial datasets, can be derived from

¹ Please note that the PISA datasets include 5-10 plausible values for student achievement in each domain. In accordance with other authors in the field, in this study only the first plausible value for each domain was used for the definition of resilient schools (e.g., Agasisti et al., 2018; Radišić & Pettersen, 2020). Additional analyses using other plausible values (available upon request) have led to comparable results which do not change the conclusions made in this study.

Table 2 Material Well-Being Variables from 2000 to 2018

	2000	2003	2006	2009	2012	2015	2018
Teacher shortage	<p>Learning hindered by shortage/inadequacy of</p> <ul style="list-style-type: none"> - Teachers - Swedish teachers - Math teachers - Science teachers 	<p>Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following?</p> <ul style="list-style-type: none"> - Qualified mathematics teachers - Qualified science teachers - Qualified Swedish teachers - Qualified foreign language teachers - Experienced teachers 	<p>Is your school's capacity to provide instruction hindered by the following issues?</p> <ul style="list-style-type: none"> - A lack of qualified science teachers - A lack of qualified mathematics teachers - A lack of qualified Swedish teachers - A lack of qualified teachers of other subjects 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - A lack of qualified science teachers - A lack of qualified mathematics teachers - A lack of qualified Swedish teachers - A lack of qualified teachers of other subjects 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Inadequate or poorly qualified teaching staff - A lack of assisting staff - Inadequate or poorly qualified assisting staff 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - A lack of qualified science teachers - A lack of qualified mathematics teachers - A lack of qualified Swedish teachers - A lack of qualified teachers of other subjects 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Inadequate or poorly qualified teaching staff - A lack of assisting staff - Inadequate or poorly qualified assisting staff
Teacher's profile	<p>Proportion of fully certified teachers: number of fully certified teachers divided by total number of teachers</p>	<p>Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following?</p> <ul style="list-style-type: none"> - Instructional materials - Computers for instruction - Computer software for instruction - Calculators for instruction - Library materials - Audio-visual resources - Science laboratory equipment and materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory equipment - Instructional materials (e.g., textbooks) - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - A lack of educational material (e.g., textbooks, IT equipment, library or laboratory material) - Inadequate or poor-quality educational material (e.g., textbooks, IT equipment, library or laboratory material) - A lack of physical infrastructure (e.g., building, grounds, heating/cooling, lighting and acoustic systems) - Inadequate or poor-quality physical infrastructure (e.g., building, grounds, heating/cooling, lighting and acoustic systems) 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - A lack of educational material (e.g., textbooks, IT equipment, library or laboratory material) - Inadequate or poor-quality educational material (e.g., textbooks, IT equipment, library or laboratory material) - A lack of physical infrastructure (e.g., building, grounds, heating/cooling, lighting and acoustic systems) - Inadequate or poor-quality physical infrastructure (e.g., building, grounds, heating/cooling, lighting and acoustic systems)
Physical educational resources	<p>In your school, how much is the learning of < 15-year-old students > hindered by</p> <ul style="list-style-type: none"> - Lack of instructional material? - Not enough computers for instruction? - Lack of instructional material in the library? - Lack of multi-media resources for instruction? - Inadequate science laboratory equipment? - Inadequate facilities for the fine arts? 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory equipment - Instructional materials (e.g., textbooks) - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials - Audio-visual resources 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory equipment - Instructional materials (e.g., textbooks) - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials 	<p>Is your school's capacity to provide instruction hindered by any of the following issues?</p> <ul style="list-style-type: none"> - Shortage or inadequacy of Science laboratory materials - Computers for instruction - Internet connectivity - Computer software for instruction - Library materials
Computer availability	<p>Computers divided by school enrollment size</p>	<p>Computers available for instruction divided by school enrollment size</p>	<p>Computers available for instruction divided by school enrollment size</p>	<p>Computers available for instruction divided by school enrollment size</p>	<p>Computers available for instruction divided by school enrollment size</p>	<p>Computers available for instruction divided by school enrollment size</p>	<p>Computers available for educational purposes divided by the number of students in the modal grade for 15-year-olds</p>

Table 3 Extracurricular Activities from 2009 to 2018

	2009	2012	2015	2018
Extracurricular activities	<p>< This academic year > , which of the following activities does your school offer to students in the < national modal grade for 15-year-olds > ?</p> <ul style="list-style-type: none"> - Band, orchestra or choir - School play or school musical - School yearbook, newspaper or magazine - Volunteering or service activities - Book club - Debating club or debating activities - School club or school competition for foreign language, math or science - < Academic Club > - Art club or art activities - Sporting team or sporting activities - Lectures and/or seminars (e.g., guest speakers such as writers or journalists) - Collaboration with local libraries - Collaboration with local newspapers 	<p>< This academic year > , which of the following activities does your school offer to students in the < national modal grade for 15-year-olds > ?</p> <ul style="list-style-type: none"> - Band, orchestra or choir - School play or school musical - School yearbook, newspaper or magazine - Volunteering or service activities - Mathematics Club - Mathematics competition - Chess club - Club with a focus on computers/Information and Communication Technology - Art club or art activities - Sports team or sports activities 	<p>< This academic year > , which of the following activities does your school offer to students in the < national modal grade for 15-year-olds > ?</p> <ul style="list-style-type: none"> - Band, orchestra or choir - School play or school musical - School yearbook, newspaper or magazine - Volunteering or service activities - Science club - Science competitions - Chess club - Club with a focus on computers/Information and Communication - Art club or art activities - Sporting team or sporting activities - < Country-Specific: Sweden: Lectures or seminars (e.g., guest speakers as writers or journalists) > 	<p>< This academic year > , which of the following activities does your school offer to students in the < national modal grade for 15-year-olds > ?</p> <ul style="list-style-type: none"> - Band, orchestra or choir - School play or school musical - School yearbook, newspaper or magazine - Volunteering or service activities - Book club - Debating club or debating activities - Art club or art activities - Sporting team or sporting activities - Lectures and/or seminars - Collaboration with local libraries - Collaboration with local newspapers

the plausible values. The boundaries for said proficiency levels were defined in the early PISA cycles when each was first a major domain. They are therefore consistent throughout the years, allowing for the comparison of achievement across countries and time. The lower boundary for level 3 is 480.18 in Reading, 482.38 in Mathematics, and 484.14 in Science (OECD, 2002, OECD, 2005, OECD, 2009).

In sum, schools within the bottom 25th percentile of the overall Swedish schools' ESCS distribution whose student body on average demonstrates achievement of at or above Level 3 in all three subjects in PISA are considered resilient. Schools with disadvantaged student bodies that do not reach Level 3 in at least one subject are considered non-resilient. Following this pattern, relatively high- and low-achieving schools with higher socioeconomic composition were grouped accordingly (see Table 4).

After defining these six school profiles for all PISA cycles, the groups were explored regarding their material and human resources. Due to varying sample sizes and non-normally distributed data, the nonparametric Kruskal–Wallis one-way analysis of variance by ranks (Kruskal & Wallis, 1952) was used to test whether the central tendencies differ across school groups. The test was followed by a pairwise comparison of groups with SPSS Bonferroni-adjusted p-values (Bland & Altman, 1995; Dunn, 1964). This Bonferroni adjustment is used to control the type-1 error rate by accounting for the number of comparisons. To do so, p-values are required to hold at the usual level (alpha at or below 0.05 in the case of the present study) after being inflated by the number of tests performed (Hox et al., 2010; IBM support, 2020). If corrected p-values remain under 0.05, groups are declared to differ significantly regarding the tested variable. All analyses were performed using SPSS, version 28.

Results

The results presented in the following are divided into two sections, focusing on one research question each.

Identification of resilient schools for different PISA cycles

This section presents the results corresponding to the first research question: *Can resilient schools be identified in Sweden, and are there changes in the number of resilient schools throughout PISA cycles from 2000 to 2018?* Fig. 2 presents the assignment of Swedish schools to resilient and other school groups throughout the seven PISA cycles. Results indicate that there are, indeed, schools that are considered resilient in each PISA cycle. In the first PISA cycle in 2000, 13.8% of the overall sample of schools were considered resilient. In other words, about half of all disadvantaged schools demonstrated an average achievement at or above Level 3 in all three subjects in PISA. Schools that fell into the higher percentiles of the ESCS distribution reached Level 3 even more often (i.e., Groups 3 and 5). Only about a quarter (27.6%) of the schools in the middle of the ESCS distribution demonstrated average achievement of below Level 3 in at least one subject (i.e., Group 4) and only 2 out of the 38 schools with the socioeconomically most advantaged student bodies fell into the lower-achieving group (i.e., Group 6) in 2000. These results highlight the previously discussed disparities in achievement across schools in regard to their socioeconomic composition.

Table 4 Definition of School Groups

		\geq Level 3 in all subjects	< Level 3 in at least one subject
ESCS distribution	Bottom 25%	Group 1 (resilient)	Group 2 (non-resilient)
	Middle 50%	Group 3 (high-achieving, medium ESCS)	Group 4 (low-achieving, medium ESCS)
	Top 25%	Group 5 (high-achieving, high ESCS)	Group 6 (low-achieving, high ESCS)

While the percentage of resilient schools was relatively high in 2000 and 2003, it decreases considerably throughout the years. An all-time low was reached in 2012, when the share of high-achieving schools decreased in all three socioeconomic levels. This may not come as a big surprise as Sweden experienced a “PISA shock” in which the average student achievement decreased substantially. As a consequence, the number of schools that can be defined as resilient decreased to only 3.8% of the overall school sample. Overall, more than half (58.7%) of Swedish schools failed to reach proficiency Level 3 and thus did not provide students with skills needed “for success later in life” (Agasisti et al., 2018, p. 8). While more socioeconomically advantaged schools seem to have recovered from this in 2015 and more schools reached Level 3 again, the group of resilient schools did not but decreased yet again to only 2.63% of the schools’ sample. In other words, only about one in ten disadvantaged schools showed an average achievement of at or above Level 3. Yet, results of the latest PISA cycle in 2018 indicate a new upward trend as the percentage of resilient schools increased to 6.31%.

In summary, the percentage of schools that can be considered resilient varies considerably across PISA cycles. While over half of the schools with a disadvantaged student body were considered resilient in the first PISA cycle in 2000, only about one in ten disadvantaged schools was considered resilient in 2015. These results support previous findings of deteriorating educational equity (Gustafsson & Yang Hansen, 2018; Yang Hansen & Gustafsson, 2019).

Comparison of material well-being

This section reports the results corresponding to the second research question: *How do resilient schools compare to non-resilient and more advantaged schools regarding their material well-being?* To provide a first overview, Table 5 shows the within-group median, mean, and standard deviation for the variables used in the study, separated for each PISA cycle. A cross-cycle comparison provides an overview of changes in the school landscape. As some indicators differ slightly throughout the years, such comparison should only be done with caution. In the cycles between 2000 and 2012, the shortage of material resources in Sweden was fairly similar to the OECD average. In 2015 and 2018, Swedish schools reported lower shortages, which may be due to the inclusion of indicators on the physical infrastructure of schools (see Table 2). Contrasting these findings is the perceived teacher shortage, which is especially high in the years 2015 and 2018. Similarly, the percentage of teachers fully certified drops from a mean of 89% in 2012 to only 78% in 2018. Less surprising may be the increase in computer availability throughout the years. In 2018, every student, on average, had access to a computer for educational purposes. Extracurricular activities were not measured in the first three PISA cycles and

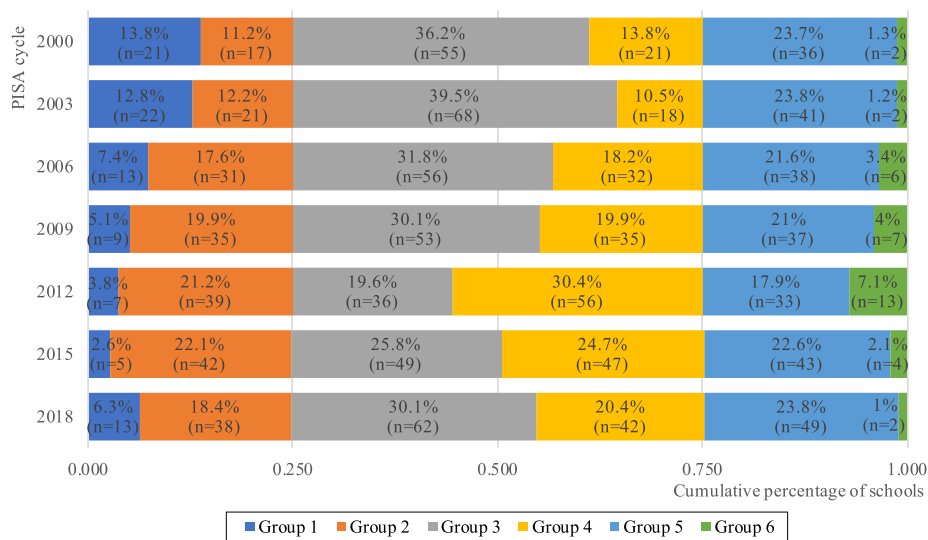


Fig. 2 School groups across PISA cycles. Group 1: resilient; Group 2: non-resilient; Group 3: high-achieving, medium ESCS; Group 4: low-achieving, medium ESCS; Group 5: high-achieving, high ESCS; Group 6: low-achieving, high ESCS

changed throughout the later years. Thus, only within-cycle, cross-group comparisons will be focused on in the following.

The six school groups were compared regarding their human and material educational resources and their extracurricular activities offered. A Kruskal–Wallis test (Table 6) indicates that there are, indeed, significant differences across groups in some cycles. Yet, a consistent pattern across the cycles cannot be detected. A pairwise test further revealed no significant differences between the group of resilient and non-resilient socioeconomically disadvantaged schools at either cycle. Even more so, there were no significant differences between groups of similar socioeconomic composition (i.e., no significant differences between the low ESCS Groups 1 and 2, the medium ESCS Groups 3 and 4, or the high ESCS Groups 5 and 6).

Overall, the group of resilient schools significantly differed from other school groups only once. A Kruskal-Wallis H test showed that in 2000, there was a statistically significant difference in perceived staff shortage scores between the different school groups, $\chi^2(5) = 24.883$, $p < 0.001$, with a mean rank score of 105.17 for the resilient group, 106.32 for the non-resilient group, 70.81 for Group 3, 67.26 for Group 4, 59.38 for Group 5 and 83.75 for Group 6. The SPSS Bonferroni-adjusted pairwise test revealed significantly higher perceived teacher shortages at resilient schools compared to the other high-achieving schools' groups with more advantaged student populations, Groups 3 ($p = 0.03$) and 5 ($p = 0.002$). Similarly, the non-resilient group reported significantly higher teacher shortages than Group 3 ($p = 0.047$) and 5 ($p = 0.003$).

Yet, no significant differences were detected when comparing resilient and non-resilient schools with socioeconomically disadvantaged student bodies. More so, no differences were found when comparing high- and low-achieving groups within the same ESCS level, indicating that high-achieving schools do not report significant differences

in their availability of resources compared to their lower-achieving counterparts. The next section of this paper will discuss these results in the Swedish context.

Discussion

Making use of secondary data from PISA, the study posed the questions as to whether resilient schools could be identified in Sweden throughout PISA cycles from 2000 to 2018 and how the material well-being of these schools compares to that of non-resilient and more advantaged schools.

First, results indicated that there are, indeed, resilient schools in Sweden and across all PISA cycles. In line with a recent study by Drossel et al. (2020), who analyzed the phenomenon of resilient schools in different countries and found an underrepresentation of resilient schools compared to other school groups, the present study found such underrepresentation of resilient schools between 2006 and 2018. However, in the earlier PISA cycles 2000 and 2003, the share of resilient schools was exceptionally high and even outweighed the group of non-resilient schools. Between 2006 and 2015, the number of resilient schools drastically decreased, reflecting a deterioration of educational equity in Sweden also reported by other studies (Yang Hansen & Gustafsson, 2016, 2019). As the average student achievement dropped in 2012 (Avvisati et al., 2019), so did the share of resilient schools. This may not be particularly surprising, as overall, fewer schools demonstrated an average achievement at or above Level 3 in 2012 than in prior PISA cycles. It does, however, imply that nine out of ten disadvantaged schools in 2015 failed to provide their student body with the skills that are said to be essential to succeed later in life (Agasisti et al., 2018). A larger share of resilient schools was detected in 2018, yielding hope for a more equitable future for Swedish schools. Yet, caution must be taken here, as Sweden reported the highest student exclusion rate (11%) among all participating economies in PISA 2018 (Avvisati et al., 2019), which may be the underlying reason for the current increase in resilient schools.

Second, after identifying resilient schools and other school types, aspects of the groups' material well-being were compared. Previous research had indicated a relationship between students' socioeconomic background and their academic achievement (see Sirin, 2005 for a meta-analytic overview), which others refer to as a relationship between the students' material and cognitive well-being (Borgonovi, 2020). Applying the well-being framework by Borgonovi and Pál (2016), this study shifted the focus towards school-level factors measuring material well-being, namely the schools' human resources (measured by perceived teacher shortage and proportion of fully certified teachers), material resources at school (measured by a perceived lack of physical educational resources and the availability of computers), and, lastly, the extracurricular activities offered by schools. Results indicated no significant differences between resilient and non-resilient schools. Even more so, no differences between any high- and low-achieving school groups within the same socioeconomic level could be detected. Thus, results suggest that equal or similar inputs in school resources do not result in equal achievement outputs. More research on the underlying factors behind the higher achievement of resilient schools is needed. While individual aspects of material well-being have been shown to explain large parts of the variation in achievement outcomes, this study does not indicate the similar importance of material well-being at the school level.

Table 5 Within-group median, mean and standard deviation of material well-being variables for all groups and cycles

	Teacher Shortage			Teachers fully certified			Shortage of Material Resources			Computer availability			Extracurricular Activities		
	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD
2000	Group 1	0.89	0.90	0.65	0.86	0.18	0.46	0.37	0.74	0.11	0.13	0.07			
	Group 2	1.15	0.94	0.85	0.83	0.09	0.29	0.00	0.91	0.13	0.14	0.03			
	Group 3	-0.17	0.13	1.04	0.90	0.09	-0.08	-0.09	0.94	0.11	0.12	0.05			
	Group 4	-0.17	0.05	0.84	0.87	0.12	0.10	0.17	0.67	0.13	0.14	0.08			
	Group 5	-0.17	-0.13	0.85	0.93	0.11	0.02	-0.10	0.91	0.14	0.19	0.24			
	Group 6	0.46	0.46	1.99	0.90	0.10	-0.37	-0.37	2.17	0.14	0.14	0.01			
Total	0.27	0.26	0.98	0.91	0.12	0.11	0.02	0.89	0.12	0.14	0.13				
2003	Group 1	0.35	0.29	1.11	0.85	0.10	-0.06	-0.19	0.90	0.14	0.15	0.07			
	Group 2	0.26	0.24	0.73	0.84	0.13	-0.06	-0.09	0.69	0.13	0.14	0.03			
	Group 3	0.07	0.02	0.98	0.86	0.15	-0.21	0.13	0.90	0.13	0.15	0.06			
	Group 4	0.07	0.06	0.72	0.86	0.10	0.02	0.19	0.63	0.16	0.16	0.05			
	Group 5	0.07	0.09	1.01	0.90	0.10	0.10	0.06	1.10	0.13	0.15	0.07			
	Group 6	-0.69	-0.69	0.73	0.85	0.08	-0.21	-0.21	0.00	0.16	0.16	0.02			
Total	0.07	0.09	0.95	0.91	0.11	-0.06	0.05	0.90	0.14	0.15	0.06				
2006	Group 1	-0.25	-0.10	0.86	0.93	0.06	0.09	-0.01	0.46	0.15	0.17	0.07			
	Group 2	0.17	-0.07	0.85	0.90	0.17	-0.39	-0.21	0.93	0.16	0.21	0.18			
	Group 3	-0.25	-0.20	0.72	0.93	0.07	-0.23	0.10	0.97	0.14	0.15	0.10			
	Group 4	-1.06	-0.38	0.95	0.94	0.07	-0.07	0.09	0.98	0.13	0.14	0.05			
	Group 5	-1.06	-0.63	0.55	0.92	0.15	0.09	0.23	0.78	0.15	0.17	0.06			
	Group 6	-1.06	-0.89	0.41	0.97	0.09	-0.07	-0.11	0.38	0.14	0.13	0.03			
Total	-0.25	-0.32	0.79	0.94	0.11	-0.08	0.06	0.88	0.14	0.14	0.10				
2009	Group 1	-0.26	-0.14	0.77	0.81	0.11	-0.13	0.04	0.77	0.49	0.64	0.62	6.00	5.78	1.99
	Group 2	-0.26	-0.31	0.68	0.92	0.12	-0.27	-0.28	0.75	0.33	0.40	0.26	6.00	5.63	2.33
	Group 3	-0.26	-0.26	0.68	0.95	0.09	0.19	0.13	0.81	0.38	0.50	0.45	6.00	5.74	2.10
	Group 4	-0.26	-0.44	0.60	0.93	0.07	-0.27	-0.13	0.68	0.32	0.37	0.20	6.00	6.06	1.94
	Group 5	-1.02	-0.50	0.70	0.95	0.17	0.03	0.24	0.81	0.35	0.47	0.34	6.00	5.68	2.21
	Group 6	-0.26	-0.12	0.74	0.80	0.23	-0.13	-0.11	0.58	0.36	0.53	0.55	5.00	4.43	2.07
Total	-0.26	-0.34	0.68	0.90	0.13	-0.13	0.01	0.78	0.35	0.46	0.37	6.00	5.71	2.13	

Table 5 (continued)

	Teacher Shortage			Teachers fully certified			Shortage of Material Resources			Computer availability			Extracurricular Activities			
	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	
2012	Group 1	-0.28	-0.24	0.97	0.92	0.88	0.09	-0.17	-0.45	0.61	0.50	0.44	0.16	5.00	5.14	1.35
	Group 2	0.15	0.23	0.88	0.90	0.90	0.08	0.02	-0.06	0.71	0.51	0.66	0.53	4.00	4.05	2.13
	Group 3	-0.28	-0.03	0.91	0.94	0.90	0.16	0.22	0.08	0.66	0.66	0.65	0.35	4.00	4.36	1.71
	Group 4	0.15	0.03	0.77	0.92	0.87	0.21	0.02	-0.06	0.82	0.48	0.57	0.36	4.00	4.18	1.75
	Group 5	-0.28	-0.16	0.78	0.97	0.90	0.18	0.22	0.34	1.07	0.68	0.75	0.38	5.00	4.91	1.65
	Group 6	-1.09	-0.71	0.66	0.95	0.88	0.23	0.02	0.35	0.71	0.84	0.70	0.31	5.00	4.46	2.33
2015	Total	0.15	-0.04	0.85	0.94	0.89	0.17	0.02	0.05	0.82	0.54	0.64	0.40	4.00	4.37	1.85
	Group 1	0.71	0.61	0.38	0.92	0.89	0.04	0.74	0.34	1.18	1.00	1.04	0.36	4.00	4.60	1.82
	Group 2	0.97	0.77	0.90	0.89	0.86	0.17	-0.40	-0.20	0.95	1.00	0.93	0.50	4.00	3.38	1.65
	Group 3	0.29	0.33	0.96	0.93	0.87	0.21	-0.13	-0.12	0.82	1.00	0.89	0.50	4.00	4.08	1.89
	Group 4	0.46	0.31	1.06	0.92	0.86	0.21	-0.48	-0.37	0.77	1.00	0.94	0.37	4.00	4.09	1.80
	Group 5	0.02	0.02	1.19	0.91	0.80	0.28	-0.65	-0.48	0.69	1.00	0.94	0.52	5.00	5.00	1.95
2018	Group 6	0.41	0.28	0.52	0.86	0.86	0.12	-0.50	-0.52	0.60	1.00	1.03	0.07	4.00	4.75	2.99
	Total	0.48	0.36	1.04	0.91	0.85	0.17	-0.33	-0.28	0.83	1.00	0.93	0.46	4.00	4.16	1.91
	Group 1	0.59	0.77	0.55	0.81	0.77	0.29	-0.07	-0.08	0.71	1.00	0.84	0.24	4.50	4.83	2.37
	Group 2	0.97	0.75	0.96	0.75	0.71	0.22	-0.45	-0.40	0.88	1.00	0.96	0.23	4.00	3.51	1.82
	Group 3	0.50	0.37	0.99	0.85	0.81	0.19	-0.31	-0.34	0.92	1.00	0.99	0.41	4.00	4.00	2.01
	Group 4	0.43	0.41	1.14	0.83	0.75	0.26	-0.69	-0.40	1.09	1.00	1.04	0.43	4.00	4.29	2.05
2018	Group 5	0.43	0.19	0.96	0.91	0.81	0.26	-0.94	0.75	0.76	1.00	1.14	1.19	4.00	4.57	2.07
	Group 6	1.22	1.22	0.45	0.68	0.68	0.09	0.47	0.47	0.52	1.30	1.30	0.42	1.50	1.50	2.12
	Total	0.58	0.44	1.00	0.83	0.78	0.23	-0.60	-0.43	0.92	1.00	1.03	0.68	4.00	4.12	2.05

Group 1: resilient; Group 2: non-resilient; Group 3: high-achieving, medium ESCS; Group 4: low-achieving, medium ESCS; Group 5: high-achieving, high ESCS; Group 6: low-achieving, high ESCS; positive values for teacher shortage and shortage of material resources refer to higher exposure to shortages than OECD average, values for teachers fully certified reflect percentages, computer availability is expressed as a ratio of computers per student, and values for extracurricular activities refer to total number of selected activities offered at schools (see "Variables" for a detailed description)

Table 6 Kruskal–Wallis H test and pairwise comparison of 6 school groups across all PISA cycles

		Teacher Shortage	Teachers fully certified	Shortage of Material Resources	Computers available to students	Extracurricular Activities	
2000	Kruskal-Wallis H	24.883	11.925	5.643	8.204		
	Asymp. Sig	< .001	.036	.343	.145		
	Pairwise Comparison of Groups (adj. sig. only)	G5-G1 (p = .002)		G2-G5 (p = .021)	NS	NS	
		G5-G2 (p = .003)					
G3-G1 (p = 0.30)							
		G3-G2 (p = .047)					
2003	Kruskal-Wallis H	3.675	8.425	1.899	3.034		
	Asymp. Sig	.597	.134	.863	.695		
	Pairwise Comparison of Groups (adj. sig. only)	NS	NS	NS	NS		
2006	Kruskal-Wallis H	16.096	7.105	6.614	9.301		
	Asymp. Sig	.007	.213	.251	.098		
	Pairwise Comparison of Groups (adj. sig. only)	NS	NS	NS	NS		
2009	Kruskal-Wallis H	5.582	8.281	8.005	1.402	3.107	
	Asymp. Sig	.349	.141	.156	.924	.683	
	Pairwise Comparison of Groups (adj. sig. only)	NS	NS	NS	NS	NS	
2012	Kruskal-Wallis H	13.567	4.926	9.123	6.279	5.880	
	Asymp. Sig	.019	.425	.104	.280	.318	
	Pairwise Comparison of Groups (adj. sig. only)	G6-G4 (p = .048)		NS	NS	NS	NS
		G6-G2 (p = .009)					
2015	Kruskal-Wallis H	12.315	3.146	6.344	4.252	15.221	
	Asymp. Sig	.031	.677	.274	.514	.009	
	Pairwise Comparison of Groups (adj. sig. only)	G5-G2 (p = .015)		NS	NS	NS	G2-G5 (p = .002)
2018	Kruskal-Wallis H	12.631	12.959	11.989	9.726	8.516	
	Asymp. Sig	.027	.024	.035	.083	.130	
	Pairwise Comparison of Groups (adj. sig. only)	G5-G2 (p = .047)		NS	NS	NS	NS

G1: resilient schools; G2: non-resilient schools; G3: high-achieving, medium ESCS schools; G4: low-achieving, medium ESCS schools; G5: high-achieving, high ESCS schools; G6: low-achieving, high ESCS schools; Pairwise comparison was run for all groups but only significant group differences at $p \leq 0.05$ after SPSS-Bonferroni correction are displayed. The group with lower average rank is listed first

Asymp. Sig asymptotic significance, adj. sig adjusted significance, NS no significant group differences after SPSS-Bonferroni correction

The group comparison in this study did not show significant differences between resilient and non-resilient schools from similar socioeconomic backgrounds. However, the study highlighted a relatively stable pattern of significant differences in the schools' perceived shortage of teachers between student bodies of different socioeconomic levels. In 2000, resilient schools reported significantly higher perceived teacher shortages than more advantaged high-achieving schools (Groups 3 and 5). In addition, the group of non-resilient schools with socioeconomically disadvantaged student populations (Group 2) also reported significantly higher perceived shortages than schools with a more advantaged student body (Groups 3, 5 and 6) in 2000, 2012, 2015 and 2018. Similarly, Gustafsson & Hansson (2016) found an unequal distribution of teacher competence between schools, especially in relation to students' migration backgrounds. In schools with a high proportion of students with a mother tongue other than Swedish, teachers were found to have the lowest competence. This lack of compensatory allocation of teacher competence, referred to as educational segregation, is considered to contribute to low student performance and achievement differences between schools. This study indicates a similar pattern in perceived teacher shortages: schools with socioeconomically more advantaged student bodies reported significantly lower teacher shortages. Yet, no significant differences between successful and less successful schools with disadvantaged student compositions were detected. In other words, there was no indication of a more compensatory distribution of resources at resilient schools, nor was there any indication that resources may explain achievement differences between high- and low-achieving schools with similar socioeconomic compositions.

Yet, certain limitations are associated with the chosen operationalization of resilient schools that weaken the interpretation of results to some extent. The use of strict, pre-defined cutoff values (i.e., proficiency Level 3) reflects the specific achievement outcome of interest (i.e., the skills needed to succeed in life) and allows for a comparison across cycles. However, the actual performance differences between resilient and non-resilient schools close to the cutoff values may in reality be negligible. Further, the resulting dichotomy of resilient and non-resilient schools has led to a severe reduction of sample size and statistical power. Therefore, inferences regarding the second research question cannot be drawn without caution, and further research with larger group sizes is needed. Differences may also occur on the classroom level, but PISA does not offer data for such analyses.

It is also noteworthy that the measure of ESCS has undergone changes in its measurement models and instruments (Avvisati, 2020). For instance, country-specific items in the household possession scale have been modified, the position of the questions within the questionnaire has changed, and the scaling model and procedures have been adapted over cycles (Avvisati, 2020). Due to societal changes, the meaning of "household possessions" has changed over time; for instance, owning a cellphone and being connected to the internet had a different meaning in 2000 than in 2018. Hence, an adaptation in the computation of the index was needed (OECD, 2019b). Overall, the comparability across countries and PISA cycles can be critiqued (OECD, 2019b; Rutkowski & Rutkowski, 2013). Although ways of improvement have been suggested (e.g., Rutkowski & Rutkowski, 2013, proposed the use of more country-specific

items), it has been proposed that the validity and comparability of the components included in the ESCS index are, nonetheless, relatively high (Avvisati, 2020; Skolverket, 2012). That being said, it is important to highlight that this study measures a school's relative position in the distribution of ESCS at a given time in the Swedish context.

The findings of the present study are somewhat contrary to previous research. Agasisti & Longobardi (2016) analyzed the characteristics of schools attended by academically resilient students from different OECD countries and found that these successful schools were richer in terms of their available educational resources and offered more extracurricular activities. This was not supported by the present study, where no significant differences in educational resources nor in the availability of extracurricular activities between resilient and non-resilient and more advantaged schools were found. The only significant difference in the availability of extracurricular activities was found in 2015, when non-resilient schools (Group 2) reported significantly lower availabilities of extracurricular activities than high-achieving schools with socioeconomically advantaged students (Group 5). The perceived shortage of material resources, as well as computer availability, did not show significant differences. While this indicates the need for further research on other underlying reasons for achievement differences across schools, the non-significant differences may also be due to differences in the operationalization of resilient schools, or they could indicate actual particularities of the Swedish school system. One of the said particularities is that extracurricular activities in Sweden, in contrast to other countries such as Germany or the United States, are often organized outside of schools (Behtoui, 2019). As the study focuses on extracurricular activities organized at schools, the variable may be less relevant in the Swedish context compared to other countries. Further, Swedish municipalities have been criticized for using only a small part of their financial resources to compensate for differences in the conditions of students (Swedish Schools Inspectorate, 2014). This may explain the non-significant differences in educational resources across school groups. The lack of compensatory resource allocation is additionally highlighted by the higher perceived teacher shortages at disadvantaged schools.

However, low or non-significant school effects in studies using international large-scale assessments are relatively common in Sweden and beyond (Wiberg & Rolfsman, 2013). A review of close to 400 studies revealed no consistent or strong effect of school resources on student performance after family inputs were accounted for (Hanushek, 1997). This is not to say that school resources do not matter but may suggest that some schools are better at using given resources than others.

Previous research on the material well-being at resilient schools is scarce. Yet, caution must be taken when transferring research results from this study into the context of another school system. Even though the Swedish school system shares some similarities with other Nordic countries and somewhat comparable conditions, it has been argued that it differs from its neighboring systems due to its distinct political approach and particularly intensive reforms (Frønes et al., 2020; SOU, 2014:5). Such differences in the educational systems are highlighted in previous research that indicates that school-level factors associated with student achievement somewhat differ across Nordic countries,

as well as over the years. For instance, a perceived lack of resources was found to negatively predict student achievement in Norway in 2003 but not in 2012, nor was such a relationship found in Denmark, Finland, Iceland, and Sweden at either of the two time points (Laukaityte & Rolfman, 2020). Another study, on the other hand, found the lack of resources in science to negatively predict achievement in Sweden in 2003 but not in 2007, nor in Norway (Wiberg & Rolfman, 2013). This unstable pattern of relationships between school resources and achievement calls for further research and the question as to why some factors are significant at specific time points and countries, unfortunately, remains unanswered for the time being.

This study adds to research in educational equity, as it highlights the changing landscape of resilient schools in Sweden and paves the way for further analyses. Existing literature has paid very little attention to resilient schools—schools which we believe to be an example of effective and equitable schools, as they “beat the odds” and report high achievement despite a socioeconomically disadvantaged student body that places them at risk for low achievement. Although the underlying reasons as to why resilient schools are more successful in compensating for socioeconomic disadvantages, unfortunately, remain underexplored, we do hope this study has raised interest in the topic and that future research will target this important but neglected group of schools.

Conclusion

This study highlighted a substantial decrease in resilient schools, which is yet another indication of deteriorating educational equity in Sweden. While the Swedish school system has undergone significant changes through various reforms in recent decades, Sweden continues to face issues of educational inequity that need further attention, both in research and policy discussions. Does the material well-being at school successfully compensate for socioeconomic differences? We can, unfortunately, not provide a clear answer to this question yet. The importance of students’ home background, as one part of their material well-being, is well established but the role of school-level indicators of material well-being is still unclear. No significant difference in any of the analyzed aspects of material well-being across resilient and non-resilient schools was found. Thus, tentatively, we could answer that no, we have not found any indication that the material well-being at school plays a role in the compensation of socioeconomic differences in the student body. Yet, caution must be taken. Due to the explorative and descriptive nature of this study, as well as some additional methodological limitations, conclusions concerning possible compensatory effects of material well-being at socioeconomically disadvantaged schools cannot be drawn without hesitation. Rather, we would like to highlight the importance of the further pursuit of the question and hope that the current study triggers the interest of other educational researchers; in Sweden and beyond. Research on resilient schools and the role of their material well-being is still in its infancy and, although we refrain from voicing specific policy implications, we believe that educational effectiveness research would certainly benefit from further research on resilient schools, as it has the potential to provide crucial information on why some schools are more successful than others in compensating for socioeconomic differences.

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Author contributions

DS analyzed and interpreted the data used in this study and drafted main parts of the manuscript. MJ provided significant input and substantially revised the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets supporting the conclusions of this article are openly accessible and can be downloaded as public use file from the OECD's website: <https://www.oecd.org/pisa/data/>.

Declarations**Ethics approval and consent to participate**

Not applicable.

Consent for publication

All authors provide consent for publications.

Competing interests

The authors declare that they have no competing interests.

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