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# Does double reduction policy offer equity in quality education addressing the academic gaps developed by socioeconomic status in China?

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## Abstract

**Purpose** – In 2021, China implemented the double reduction policy, aiming to promote more equitable and sustainable learning environments. This study aims to investigate whether the policy reshaped over time the relationship between family socioeconomic status (SES) and academic achievement and whether its effects varied when comparing public and private schools.

**Design/methodology/approach** – Using a quasi-experimental longitudinal research design and relying on naturally occurring variations across time (before vs during policy implementation) and school type (public vs private), students' performance data were observed before 2020 and after 2022. Regression analysis, moderation models and heterogeneity tests were conducted. Academic achievement was measured using standardized composite scores in Chinese, mathematics and English; SES was constructed from household income and parental education.

**Findings** – SES remained a significant predictor of academic achievement in both public schools ($\beta = 0.37$, $R^2 = 0.14$ in 2020) and private schools ($\beta = 0.42$, $R^2 = 0.18$ in 2020). However, its influence weakened significantly in public schools ($\beta = 0.16$ in 2022), while in private schools it slightly increased ($\beta = 0.45$, $R^2 = 0.20$ in 2022).

**Originality/value** – From a sustainable education perspective, the findings suggest that regulatory reforms can contribute to educational sustainability by reducing students' reliance on family background rather than by increasing short-term performance levels.

**Keywords** Sustainable education, Educational equity, Socioeconomic status, Double reduction policy, Academic achievement

**Paper type** Research paper



*Conflict of interest:* The authors declare that they have no competing interests.

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## Introduction

Whether education functions as a vehicle for social mobility or instead reproduces existing socioeconomic hierarchies remains a long-standing and unresolved debate. While education has long been regarded as a mechanism through which individuals can improve their social standing (Rahman, 2024), a growing body of research suggests that education systems may also privilege already advantaged groups, thereby reinforcing structural inequalities rather than mitigating them (Darmawaskita and McDaniel, 2021). This tension is particularly salient in basic education, where early academic outcomes often shape students' long-term learning trajectories and life chances (Baig *et al.*, 2025; Bi and Liu, 2024).

In response to persistent educational inequalities, numerous policy initiatives have been introduced worldwide to reduce the influence of family socioeconomic status (SES) on educational outcomes (Cabral-Gouveia *et al.*, 2023). However, some of these initiatives have been criticized for adopting a fragmented or short-term perspective, addressing inequality at specific stages or within particular institutional arrangements without sufficiently engaging with its structural and cumulative nature. For instance, vocational education and training (technical education and vocational training) has frequently been promoted as an equalizing pathway for socially disadvantaged students, yet empirical evidence indicates that it often becomes socially stratified, concentrating marginalized learners rather than reducing inequality (Rehman *et al.*, 2025). Similarly, the expansion of tertiary education has not necessarily weakened socioeconomic disparities, as students from higher-SES backgrounds continue to be overrepresented in more prestigious institutions and programs (Gui *et al.*, 2024).

These patterns point to a critical insight: inequalities that emerge during basic education are rarely fully compensated for at later stages of the education system. Instead, academic gaps associated with family background tend to persist or even widen over time (Liu *et al.*, 2022; Hung *et al.*, 2020). As a result, interventions implemented at post-compulsory stages often arrive too late to fundamentally alter students' educational trajectories. This has shifted scholarly attention toward basic education as a pivotal arena for addressing inequality at its roots.

Importantly, achieving universal access to basic education does not in itself guarantee educational equity (Zickafoose *et al.*, 2024). Universal education primarily concerns access and participation, whereas equity refers to whether students' learning outcomes are systematically shaped by their socioeconomic background (Rad *et al.*, 2022). Although standardized curricula and unified educational provision may foster shared civic values and foundational skills (Yang and Guo, 2020), such arrangements do not automatically prevent inequality. This is especially the case if families retain unequal capacities to convert socioeconomic resources into academic advantage through supplementary learning (Baikenov and Hajar, 2025), residential sorting or school choice mechanisms (Singer, 2025).

From the perspective of sustainable education, this distinction becomes particularly consequential. Sustainable education is increasingly understood not only as an emphasis on curricular relevance or environmental awareness, but also as the capacity of education systems to generate durable and equitable outcomes over time (Alam, 2025). In this framework, educational sustainability is undermined if students' academic success continues to depend heavily on family socioeconomic background, even within systems that are formally universal and tuition-free. Equity, therefore, is not merely an aspirational principle but a core criterion for evaluating the long-term sustainability of education systems.

Basic education occupies a foundational position in this regard. If socioeconomic disparities in academic achievement are firmly established during compulsory schooling, they are unlikely to be fully mitigated at subsequent stages that feature increased selectivity

and stratification (Hung *et al.*, 2020). Consequently, ensuring that basic education weakens – rather than reinforces – the dependence of academic outcomes on family background is essential for enabling education to function as a sustainable driver of social mobility (Decker *et al.*, 2025).

Despite widespread commitments to "free basic education for all," the coexistence of public, private and international schooling options has introduced new forms of stratification within ostensibly universal systems (Wright, 2025). While universal provision secures minimum access, families with greater socioeconomic resources often retain the ability to pursue higher-quality or elite educational pathways, thereby preserving advantages within a diversified education landscape (Marginson, 2019). Under such conditions, the central challenge for sustainable education is not whether schooling is universally available, but whether educational outcomes become less dependent on family SES over time.

Against this backdrop, evaluating education policy reforms requires moving beyond short-term indicators such as participation rates or workload reduction to examine whether such reforms can alter the structural relationship between SES and academic achievement. Assessing whether major policy interventions weaken students' reliance on family background for academic success is therefore critical for understanding whether education systems are progressing toward more equitable and sustainable outcomes.

*Research problem, gap and scope*

China's basic education system is overwhelmingly dominated by public schools, which enroll approximately 96.3% of all students, while the remaining 3.7% are distributed across private schools, including ordinary private school, Chinese bilingual school and international school (MOE, 2025). Comparing with public schools which are required to strictly follow a unified National Curriculum, ordinal private schools enjoy greater flexibility in curriculum enrichment, internationalized schools highlight the integration of Chinese and international orientations. International schools cater for foreign passport holders and only operate autonomously outside the Chinese national education system (Wu and Koh, 2022). This institutional differentiation has resulted in a stratified educational landscape characterized by unequal access to education opportunities, quality and outcomes (Wright *et al.*, 2022).

Although basic education in China is designed to be tuition-free and universal, access to high-quality educational resources remains unevenly distributed across families and schools. Elite education, referring to high-performing private school and Chinese internationalized schools, is typically associated with substantial tuition fees. For instance, bilingual schooling charges average annual fees of US$30,069 in Shanghai and US$24,619 in Guangdong Province (Wright *et al.*, 2022; NewSchool Insight, 2019). This structural disparity implies that families who enjoy high SES are substantially better positioned to secure high-quality or elite education for their children through market-based mechanisms, while the majority of families rely primarily on the public education system.

Importantly, inequalities persist even within the public education sector. Resources and school quality vary considerably across regions, as well as among schools within the same locality (Dai and Tan, 2025). Moreover, school enrollment in compulsory education is closely tied to residential location, with students typically allocated to nearby schools based on household registration and housing ownership (Han *et al.*, 2021). Consequently, access to high-quality public schools has become increasingly capitalized through the housing market, effectively transforming education opportunities into a function of family socioeconomic resources (Jin *et al.*, 2023; Han *et al.*, 2021). Under such institutional arrangements, families' SES is indirectly converted into educational advantage via residential sorting and school stratification (Xu and Wu, 2022).

In this context, family SES has emerged as a key structural determinant of students' academic outcomes. Rather than serving as a mechanism for reducing inequality, the education system may unintentionally reproduce or reinforce existing socioeconomic disparities. From the perspective of educational equity, a critical question is therefore whether policy interventions can weaken students' reliance on family background for academic success.

In response to these challenges and in alignment with the principles of the United Nations Sustainable Development Goal 4, which emphasizes inclusive, equitable and high-quality education, the Chinese government introduced the Double Reduction policy in 2021 (Li *et al.*, 2023). This policy seeks to alleviate the influence of family socioeconomic background on educational outcomes through two primary mechanisms. First, on the supply side, it imposes stringent regulations on "shadow education" by restricting the expansion of the private tutoring industry, thereby aiming to reduce inequalities in access to supplementary educational resources (Li *et al.*, 2023). Second, at the school level, it expands after-school services to provide diversified academic support and enrichment activities, with the intention of meeting students' heterogeneous learning needs and fostering their long-term development (Zhou and Fan, 2025).

Despite these ambitions, the extent to which the Double Reduction policy has contributed to sustainable educational equity remains insufficiently examined. Existing research has largely focused on short-term outcomes such as changes in students' workload and well-being (Zhou and Fan, 2025; Sun, 2024; Wang *et al.*, 2022), parental anxiety (Ren and Zhao, 2024; Jin and Sun, 2022), teacher workload (Yongtao, 2025) or participation in shadow education, often relying on cross-sectional survey data collected after policy implementation. While such studies shed light on immediate behavioral responses, they offer limited insight into whether the policy has altered the structural relationship between family SES and academic achievement. This is central to evaluating progress being made to produce equitable and sustainable education.

Moreover, relatively little attention has been paid to potential heterogeneity in policy effects across school sectors. Public and private schools operate under markedly different institutional conditions with respect to school service (Guo *et al.*, 2025), curriculum regulation (Feng, 2023) and resource allocation (Liu, 2023). As a result, the extent to which the double reduction policy can mitigate socioeconomic disparities in academic achievement may vary systematically between public and private schools. Empirical evidence directly comparing these sectors using longitudinal data remains scarce.

From a sustainable education perspective, sustainability is not limited to curricular reform or environmental education but also encompasses the capacity of education systems to produce durable reductions in inequality (Alam, 2025). In this regard, changes in the strength of the SES–achievement association over time provide a critical empirical indicator of whether policy reforms contribute to sustainable equity rather than short-lived redistribution (Gui *et al.*, 2024). Evaluating the double reduction policy through this lens allows for an assessment of whether it advances the SDG4 objective of ensuring that educational outcomes are less dependent on family socioeconomic background.

The scope of this study is intentionally focused. Rather than examining subject-specific effects or a broad range of policy consequences, the analysis considers students' overall academic performance as a composite outcome and concentrates on a core question in educational inequality research: whether a major policy reform can weaken students' dependence on family socioeconomic background for academic achievement. Through this SDG-oriented and equity-focused approach, the study contributes to a clearer understanding

of how education policy reforms may support sustainable and inclusive development within stratified education systems.

*Research purpose, objective and questions*

The primary purpose of this study is to examine whether the implementation of China's double reduction policy altered the relationship between family SES and students' academic performance. In addition, this study aims to investigate whether the policy's effects differ between public and private school sectors, given their distinct institutional characteristics and resource environments. From a broader perspective, the study situates the evaluation of the double reduction policy within a sustainable education framework, conceptualizing reductions in students' dependence on family socioeconomic background for academic success as an indicator of sustainable and equitable educational development:

*RQ1*. To what extent did the strength of the association between students' socioeconomic status and academic performance change following the implementation of the double reduction policy and do these changes differ between public and private schools?

*RQ2*. Does the double reduction policy significantly moderate the relationship between socioeconomic status and academic performance?

*RQ3*. Is the moderating effect of the double reduction policy on the SES–academic performance relationship heterogeneous across public and private school sectors?

*RQ4*. From a sustainable education perspective, does the double reduction policy contribute to more equitable and sustainable educational outcomes by reducing students' reliance on family socioeconomic background for academic achievement over time?

International literature will be reviewed sequentially to provide a critical theoretical lens.

## Literature review

Initially, a theoretical background and the summarization of the relationship between family SES and students' academic performance will be illustrated. Subsequently, the shadow education industry as a reproductive mechanism of socioeconomic academic inequalities, as well as the institutional arrangement of China's private and public school are demonstrated. Finally, the sustainable education development in a perspective of equity was discussed.

*Theoretical background*

Following the suggestion of Alam *et al.* (2026) and Wang *et al.* (2026), the human capital theory by Gary Becker and social reproduction theory by Pierre Bourdieu and Samuel Bowles serves as the theoretical framework for this research. While these frameworks offer contrasting assumptions, they are analytically complementing each other. Human capital theory views education as an investment that increases skills and productivity, leading to increased productivity and earnings for both individual and society, subsequently improving social mobility (Indrawati and Kuncoro, 2021). Since Becker (1962) proposed human capital theory, it has garnered great attention with many educational policies targeted to increase the quality of education provided for the citizens. Thus, universal basic education is assumed to raise productivity because it imparts fundamental skills, technologies and socialize people into functioning effectively in society and economy (Marginson, 2019).

Yet, criticisms of human capital theory argued that education systems function not merely as neutral mechanism of skill formations, rather as institutions that reproduce existing social hierarchies – social reproduction theory (Luo *et al.*, 2022). Thus, schools tend to align with dominant forms of social capital/cultural capital and reinforce structural inequalities (Backer and Cairns, 2021). As such, despite universal basic education is widely considered as fundamental human right aimed to improve human capital and China's double reduction policy is aimed to enhance equality and ensure sustainable quality education (SDG 4). In practice, these reforms may privilege students who are already advantaged with higher SES and cultural resources, thereby reproducing structural inequalities despite their egalitarian intentions.

*Socioeconomic status and academic achievement*

A substantial body of research has consistently demonstrated that students' academic achievement is closely associated with family SES (Song and Tan, 2025; Gui *et al.*, 2024; Liu *et al.*, 2022). Across diverse education systems, students from higher-SES families tend to achieve better academic outcomes than their lower-SES peers, owing to differences in economic resources, parental education, cultural capital and access to mechanism that support learning (Gu *et al.*, 2024; Yang, 2023; Finch and Finch, 2022). These advantages accumulate over time and shape students' learning trajectories in systematic ways.

Importantly, existing literature treats the association between SES and academic achievement not as a contested empirical question, but as a well-established regularity in educational research. Consequently, many studies have shifted their analytical focus away from whether SES matters toward how strongly educational outcomes depend on family background and under what institutional conditions this dependence may be weakened (Gu *et al.*, 2024; Finch and Finch, 2022). The strength of the SES–achievement association – often referred to as the socioeconomic gradient – has therefore become a widely used indicator of educational inequality (Song and Tan, 2025; Liu *et al.*, 2022).

In the Chinese context, this gradient has been reinforced by structural features of the education system, including competitive examinations (Liu and Helwig, 2022), hierarchical school structures (Tan, 2022) and uneven access to high-quality instructional resources (Song and Tan, 2022). Although compulsory education is formally universal and tuition-free, empirical studies suggest that family background continues to exert a substantial influence on academic outcomes (Liu *et al.*, 2022; Zhao *et al.*, 2023). Findings mentioned above provide the theoretical and empirical foundation for examining whether policy interventions can alter the degree to which academic achievement depends on family SES.

*Shadow education, policy intervention and the double reduction reform*

Shadow education, commonly defined as fee-based private tutoring that supplements formal schooling, has been widely identified as a key mechanism through which families convert socioeconomic resources into academic advantage (Baikenov and Hajar, 2025; Faiza and Daud, 2023). Extensive research indicates that higher-SES families are more likely to invest in private tutoring and other forms of supplementary education, thereby amplifying existing disparities in academic achievement (Jansen *et al.*, 2023).

In response to growing concerns about educational inequality and excessive academic competition, governments in several countries have attempted to regulate the private tutoring sector (Bray, 2025). China's Double Reduction policy, introduced in 2021, represents one of the most comprehensive interventions targeting shadow education. The policy seeks to reduce students' academic burden and curb educational stratification by restricting the

expansion of private tutoring while strengthening school-based support systems (Qian *et al.*, 2024).

From a theoretical perspective, the double reduction policy has the potential to reshape the relationship between family SES and academic achievement through two interrelated channels. First, by limiting access to shadow education, the policy may reduce families' ability to translate economic resources into academic advantage (Tan and Liu, 2023). Second, by expanding after-school services within schools, the policy may provide more equitable access to academic support that was previously available primarily through private means (Wang *et al.*, 2025). This logic leads to a testable expectation regarding the role of the policy as a moderating force in the relationship between SES and academic achievement (Wang *et al.*, 2025).

Hence, the hypothesis for the second research question was proposed, as follows. *H1*: Double Reduction policy has no significant moderating effect on the academic performance of students among various SES.

*Institutional context and sectoral heterogeneity: public and private schools*

Education policies are embedded within institutional contexts that shape their implementation and effectiveness (Muthanna and Sang, 2023). In China, public and private schools operate under markedly different regulatory frameworks (Liu, 2023). Public schools are subject to centralized oversight, standardized curricula and uniform policy enforcement, whereas private schools often enjoy greater autonomy in curriculum design, instructional practices and resource allocation (Liu, 2023).

These institutional differences suggest that the effectiveness of the Double Reduction policy in weakening the SES–achievement relationship may vary across school sectors (Yang *et al.*, 2023). In public schools, the regulation of shadow education and the expansion of after-school services are more likely to directly reshape students' learning environments, potentially reducing dependence on family-provided resources. By contrast, private schools – particularly elite private or bilingual institutions – may have greater capacity to adapt to policy constraints through alternative instructional practices or informal enrichment opportunities. Families with higher SES may also possess additional means to compensate for policy restrictions, thereby limiting the policy's equity effects (Liu *et al.*, 2024).

Despite the importance of institutional heterogeneity, empirical research directly comparing the equity implications of the Double Reduction policy across public and private schools remains limited, particularly using longitudinal data. Building on this institutional perspective, the present study explicitly examines whether the moderating effect of the policy differs by school sector. Posited here is *H2*: the moderating effect of the Double Reduction policy on the SES–academic performance relationship is not heterogeneous across public and private school sectors.

*Sustainable education, educational equity and SES dependence*

An emerging strand of literature emphasizes the importance of evaluating education reforms from a sustainable education perspective (Wu *et al.*, 2022). Within this framework, sustainability is understood not only in terms of curricular innovation or environmental education, but also with reference to the capacity of education systems to produce durable and equitable outcomes over time (Alam, 2025). Central to this perspective is the principle articulated in United Nations Sustainable Development Goal 4 (SDG4) 4, which calls for inclusive and equitable quality education (Rad *et al.*, 2022).

From an equity-oriented sustainability perspective, a critical indicator of sustainable educational development is whether students' academic success becomes less dependent on

family socioeconomic background (Gui *et al.*, 2024). Policies that yield short-term redistribution without altering the underlying relationship between SES and academic achievement may produce temporary improvements but fail to generate lasting equity, for instance the school enrollment reform in China (Jin *et al.*, 2023; Han *et al.*, 2021). In contrast, reforms that weaken the structural dependence of educational outcomes on family background contribute to more sustainable and inclusive education systems, like the construction of Finland education (Yang *et al.*, 2022).

Evaluating changes in the strength of the SES–achievement association over time therefore provides a meaningful lens for assessing the sustainability of education reforms (Gui *et al.*, 2024). If the Double Reduction policy leads to a persistent weakening of this association – particularly within the public education system – it may be interpreted as contributing to sustainable educational equity. Conversely, if SES dependence remains unchanged or re-emerges through alternative mechanisms, the policy's long-term contribution to sustainable education may be limited.

Building on this perspective, the present study treats sustainable education not as an abstract normative ideal but as an empirically assessable outcome, operationalized through changes in the SES–academic achievement relationship over time.

## Methods

This study used a quasi-experimental longitudinal design to examine whether China's Double Reduction policy facilitated educational equity by altering the relationship between students' SES and academic achievement. Because the policy was implemented nationwide and was not randomly assigned, the study relied on naturally occurring variations across time (before vs during policy implementation) and school type (public vs private), making a quasi-experimental approach the most appropriate.

### *Population and sampling*

Owing to the particular nature and scope of the study, privacy concerns and lack of published comprehensive data, which is common in developing countries, Guilin city in Guangxi province, China was purposively chosen. The population of this study includes a cohort of Grade 7 students who entered middle school in 2020. There were 42 middle schools in Guilin municipal region, 27 of them were public and 15 were non-public schools, with 10,050 and 58,00 registered students, respectively. The ratio sampling technique was deployed to select two public school and one private school. Sampled schools were chosen for reasons of accessibility and availability and eventually, 593 respondents were selected including 409 from public schools and 184 from the non-public counterpart. This study adopted census approach to select 593 students because the total population (409 + 184) is manageable in size and feasible to include every eligible student. Moreover, this technique maximizes statistical power and eliminates bias and sampling error (Lakens, 2022). Moreover, this sampling frame was determined from the official school records (school register) which provided accurate record of eligible students.

### *Data collection methods*

Data collection was conducted between June 7, 2024 and August 25, 2024. Prior to fieldwork, ethical approval was obtained from the university, followed by official permission from each participating school. The research team subsequently visited the schools to introduce the purpose of the study and clarify the type of data required.

Participants were informed that their involvement was voluntary and that they could withdraw at any stage without any adverse consequences. Secondary data on students'

academic performance were retrieved from the publicly accessible archives of the school website. In addition, primary data on students' SES were collected through an online questionnaire. With the assistance of the class teachers, the questionnaire link was disseminated via WeChat in each classroom group, enabling students to access and complete the instrument. Class teachers then compiled and shared the anonymized responses with the researcher.

Furthermore, teachers were responsible for obtaining written parental consent from the students' guardians and all consent forms were securely stored by the schools. Importantly, no personal identifiers or original consent documents were provided to the researcher, ensuring that confidentiality and data protection requirements were upheld throughout the study.

To be clear, ethical issues were respected. After collecting the data, each school was classified based on the school type, public and non-public. Besides, all respondents' information was given to the researcher without any identifiable information. Only the students' number served as the clue for matching their academic performance with students' family SES. Therefore, confidentiality was ensured and the data collection remained private.

*Variable construction and instrument*

Academic achievement was assessed using students' end-of-semester examination scores in Chinese, Mathematics and English for the years 2020 (before policy implementation) and 2022 (during policy implementation) (Zhou and Fan, 2025; Tan and Zhai, 2025). Because each of the three participating schools used its own internally designed examinations, raw scores were not comparable across schools or years. To ensure comparability, all academic scores were standardized within each combination of school, year and subject. This procedure adjusts for differences in test difficulty and grading standards across schools while producing a measure of students' relative standing among their school peers. The resulting indices reflect students' overall academic position within their school cohort in 2020 and 2022, respectively.

Students' SES was measured using five indicators collected in 2020 (Chen, 2022): family monthly income (eight ordered categories), parents' education level (seven ordered categories) and parental occupational class (ten ordered categories). Following the OECD's student economic, cultural and social status methodology, each SES indicator was first standardized across the full sample to obtain *Z*-scores. The five *Z*-scores were then summed to create a raw composite score, which was subsequently standardized again to yield the final SES index (Song and Tan, 2025; Avvisati and Wuyts, 2024). Higher scores reflect a more advantaged socioeconomic position.

Double Reduction policy was given pseudo numbers "0" and "1", representing the time before and after the "double reduction" policy, respectively, according to previous practice (Jin *et al.*, 2023; Han *et al.*, 2021). To be clear, this variable does not function as a psychological moderator, but instead as a structural policy moderator.

Other confounding variables include school type which was dummy coded to "0" and "1" representing public and non-public schools, respectively. In addition, gender served as the control variable with "0" and "1" representing male and female. It was worth noting that all categorical variables involved were not standardized.

*Data analysis*

Demographic information was presented to provide insight into the basic profile of the participants. Descriptive statistics regarding central tendency and variability were computed to summarize the distribution of the SES index to give a primitive analysis of the data.

Meanwhile, the baseline socioeconomic inequality was checked out to ensure the whole research was off in the right direction.

Linear regressions between SES and academic performance index were calculated separately for: public schools (2020 and 2022) and private school (2020 and 2022). These subgroup regressions allowed observation of whether the strength of the SES–achievement association changed before and during policy implementation within each school type.

To formally evaluate the impact of the "double reduction" policy on SES-related inequality, a series of regression models was estimated. First and foremost, separate regressions were conducted for public and non-public sections to examine how the SES–academic performance relationship changes. Sequentially, a pooled longitudinal regression model was established by creating the interaction term of SES, the "double reduction" policy and school types, to determine the policy's effect in influencing the SES–performance inequality that occurs between public and private schools.

## Findings and discussion

### *Descriptive trends and baseline inequality*

This study draws on a balanced panel of 593 students observed before (2020) and after (2022) implementation of China's double reduction policy, with identical school composition across waves. The sample includes two public schools ($N = 409$) and one private school ($N = 184$), enabling consistent comparisons to be made across time and school sectors.

Descriptive evidence reveals clear socioeconomic stratification across school types. Although the SES index was standardized at the full-sample level, students in public schools exhibit (Table 1) a below-average socioeconomic position ($M = -0.17$, $SD = 0.97$), whereas students in the private school are substantially more advantaged ($M = 0.37$, $SD = 0.96$). Importantly, the dispersion of SES is similar across sectors, indicating that socioeconomic heterogeneity exists within both public and private schools.

Prior to policy implementation, a pronounced SES gradient in academic achievement is evident. In 2020, SES is strongly associated with academic performance in both public schools ($\beta = 0.37$, $R^2 = 0.14$) and private schools ($\beta = 0.42$, $R^2 = 0.18$), establishing a clear baseline of socioeconomic inequality in academic outcomes. This pre-policy structure provides a necessary reference point for evaluating whether and how the double reduction policy altered the relationship between family background and academic achievement.

### *Changes in the SES–achievement gradient before and after the policy (RQ1)*

Comparisons across time reveal markedly different trajectories in the SES–achievement relationship across school sectors and the results are summarized in Table 2. In public schools, the strength of the SES gradient declined sharply following the policy's implementation: the standardized SES coefficient dropped from $\beta = 0.37$ in 2020 to $\beta = 0.16$ in 2022, with the proportion of variance explained by SES falling from 14.3% to

**Table 1.** Descriptive statistics

| School sector | *N* | SES Mean | SES SD | SES-AP $\beta$ (2020) | $R^2$ (2020) |
|---|---|---|---|---|---|
| Public | 409 | −0.17 | 0.97 | 0.37*** | 0.14 |
| private | 184 | 0.37 | 0.96 | 0.42*** | 0.18 |

**Source(s):** Authors' own creation

**Table 2.** SES–achievement associations before and after the double reduction policy

| School sector | Year | SES $\beta$ | $R^2$ |
|---|---|---|---|
| Public | 2020 | 0.37*** | 0.14 |
| Public | 2022 | 0.16** | 0.03 |
| Private | 2020 | 0.42*** | 0.18 |
| Private | 2022 | 0.45*** | 0.20 |

**Source(s):** Authors' own creation

2.5%. This substantial flattening suggests a weakening of the link between family socioeconomic background and academic performance within public schools.

By contrast, the SES–achievement relationship in private schools remained strong and stable over time. The standardized SES coefficient increased slightly from $\beta = 0.42$ to $\beta = 0.45$, and the explanatory power of SES remained high ($R^2 \approx 0.20$). These divergent patterns indicate that the reduction in socioeconomic inequality observed after the policy was implemented, did not appear to be uniform across school sectors, pointing to potential differences in policy reach and institutional context.

At this stage, these findings document structural change rather than causal attribution. They nonetheless suggest that the double reduction policy coincided with a substantial attenuation of socioeconomic inequality in academic achievement within public schools, while leaving the private school sector largely unaffected.

*Moderating effect of the double reduction policy (RQ2)*

To formally test whether the double reduction policy moderated the association between SES and academic achievement (*RQ2*), a full-sample moderation model was estimated, including SES, policy exposure and their interaction. The results provide clear evidence of a moderating effect.

SES remains a strong predictor of academic achievement ($\beta = 0.39$, $p < 0.001$), confirming the enduring role of family background. Notably, the direct effect of the double reduction policy on achievement is statistically insignificant ($\beta \approx 0$, $p = 1.000$), indicating that the policy did not produce a uniform shift in average performance levels. This aligns with the policy's stated aim of regulating educational practices rather than directly boosting test scores (Qian *et al.*, 2024).

Crucially, the interaction between SES and the double reduction policy is negative and statistically significant ($\beta = -0.13$, $p = 0.001$). This result provides clear evidence that the strength of the SES–achievement relationship weakened following policy implementation. Therefore, *H1* which assumes that the double reduction policy has no significant moderating effect on the academic performance of students among various SES, is rejected. Substantively, the academic advantage associated with higher SES became less pronounced after the policy took effect, despite the fact that average performance levels remained unchanged.

This pattern supports the interpretation of the double reduction policy as an equity-oriented intervention rather than a performance-enhancing reform (Niu *et al.*, 2025). By constraining excessive homework and shadow education, the policy appears to have reduced the channels through which family economic and cultural capital could be translated into academic gains (Niu *et al.*, 2025; Yang *et al.*, 2023). Such a mechanism-based interpretation is consistent with broader policy research emphasizing the role of regulation in reshaping the distributional logic of educational outcomes (Chen and Lin, 2024).

*Heterogeneous effects across school sectors (RQ3)*

To examine whether the moderating effect of the double reduction policy varies by school sector (*RQ3*), a triple-interaction model was estimated including SES, policy exposure, school type and all lower- and higher-order interaction terms. The results reveal suggestive but not definitive evidence of heterogeneity.

Consistent with previous analyses, SES remains a strong predictor of achievement ($\beta = 0.42$, $p < 0.001$) and the SES × policy interaction remains negative and statistically significant ($\beta = -0.19$, $p < 0.001$), indicating an overall policy-induced weakening of the SES gradient (Table 3). The three-way interaction among SES, policy exposure and school type is positive and marginally significant ($\beta = 0.09$, $p = 0.071$), so it fails to reject *H2*.

Although this coefficient does not meet the conventional 5% significance threshold, its direction and magnitude are substantively meaningful and fully consistent with earlier sector-specific findings. The positive sign indicates that the policy's inequality-reducing effect was weaker in private schools than in public schools. In other words, while the Double Reduction policy moderated the SES–achievement relationship overall, its effectiveness was not evenly distributed across school sectors.

From an institutional perspective, this pattern is plausible. Public schools are subject to stricter regulatory oversight regarding homework loads and off-campus tutoring, limiting the ability of high-SES families to deploy supplementary resources (Chen *et al.*, 2022). Private schools, by contrast, often retain greater flexibility in instructional intensity and enrichment activities, allowing socioeconomic advantages to persist despite policy constraints (Claes and Moulin, 2026).

Taken together, the marginal significance of the triple interaction should not be interpreted as evidence of no heterogeneity. Rather, it suggests asymmetric policy effects that are concentrated in the public education system, with attenuated influence in the private sector. Given the relatively smaller private-school sample and the inherent difficulty of detecting higher-order interactions, these findings point to meaningful but uneven equity effects (Table 4).

*Implications for sustainable education and equity (RQ4)*

From a sustainable education perspective, the findings suggest that the double reduction policy contributed to greater educational equity by reducing students' dependence on family socioeconomic background for academic achievement, particularly in public schools. Rather than increasing average performance, the policy reshaped the mechanisms through which educational advantages are generated and maintained, consistent with sustainability-oriented approaches to education reform (Chen and Lin, 2024).

The results highlight an important distinction between equality of outcomes and equality of opportunity. By weakening the SES–achievement gradient, the policy reduced the extent to which family resources could be converted into academic advantage, thereby promoting a

**Table 3.** Moderating effect of the double reduction policy on academic achievement

| Predictor | $\beta$ | SE | $p$ |
|---|---|---|---|
| SES_index | 0.394 | 0.027 | <0.001 |
| Double reduction policy (DRP) | 0.000 | 0.038 | 1.000 |
| SES × policy | −0.129 | 0.038 | 0.001 |
| Gender | −0.014 | 0.039 | 0.625 |

**Source(s):** Authors' own creation

**Table 4.** Heterogeneous moderating effects by school type

| Predictor | B | SE | *p* |
|---|---|---|---|
| SES_index | 0.419 | 0.033 | <0.001 |
| Double reduction policy (DRP) | −0.022 | 0.046 | 0.513 |
| School type (private = 1) | −0.105 | 0.061 | 0.010 |
| SES × policy | −0.186 | 0.047 | <0.001 |
| SES × school type | 0.002 | 0.060 | 0.962 |
| Policy × school type | 0.021 | 0.087 | 0.638 |
| SES × policy × school type | 0.089 | 0.085 | 0.071 |

**Source(s):** Authors' own creation

more level playing field within compulsory education. At the same time, the persistence of strong SES effects in private schools underscores the limits of regulatory interventions in pluralistic education systems and points to the need for complementary policies that address institutional heterogeneity (Zhou and Fan, 2025).

Overall, this study contributes to the literature on sustainable education by demonstrating that policy reforms can enhance equity not by raising aggregate performance, but by altering the structural pathways linking socioeconomic background to academic outcomes. Such distribution-sensitive reforms may represent a critical, though often overlooked, dimension of sustainability in education systems undergoing rapid social and institutional change.

## Conclusion and limitations

This study examined whether China's double reduction policy reshaped the relationship between family SES and academic achievement, drawing on longitudinal data from public and private schools before and after the policy's implementation. By combining descriptive analyses, moderation models and heterogeneity tests, the findings provide a coherent picture of how the policy influenced educational inequality over time.

The results show that although SES remained a strong predictor of academic achievement overall, the strength of this association declined significantly following the policy's implementation. Importantly, this attenuation was not driven by improvements in average achievement levels, but by a weakening of the mechanisms through which family socioeconomic resources translated into academic advantage. This pattern suggests that the double reduction policy functioned primarily as an equity-oriented intervention rather than a performance-enhancing reform, consistent with its regulatory objectives (Qian *et al.*, 2024).

Further analyses reveal that the policy's moderating effect was uneven across school sectors. Evidence from subgroup comparisons and a triple-interaction model indicates that the reduction in the SES–achievement gradient was more pronounced in public schools, while the association remained strong in private schools. Although the heterogeneity effect is marginally significant, its direction and consistency with institutional differences point to asymmetric policy impacts shaped by regulatory scope and school governance structures (Yang *et al.*, 2023). From a sustainable education perspective, these findings highlight the importance of addressing not only outcomes, but also the structural pathways through which inequality is reproduced.

In a global perspective, the China case contributes to ongoing international discourse on equality in education, privatization and shadow education. In many parts of the world, like south Korea's "no homework", Singapore's "learn for life and shifting assessment", Germany's "all-day schooling" and many more grabble with the widening SES achievement

gaps despite increasing access to schools. Many of these reforms are aimed at regulating private tutoring markets, standardizing curricula and controlling tuition, yet evidence of their effect remains mixed. This study's findings indicate that regulatory intervention can moderate the SES achievement association, particularly within the public sectors. However, inequality is often persistent especially where market-oriented schooling structures/commodification of education remain influential.

Several limitations should be acknowledged. First, the analysis relies on data from a limited number of schools, which may constrain the generalizability of the findings. Second, SES was treated as time-invariant, preventing examination of dynamic changes in family circumstances. Third, although the policy timing provides a quasi-experimental context, unobserved confounding factors cannot be fully ruled out. Future research should draw on larger, more diverse samples and longer time horizons to assess the durability of policy effects and to explore complementary mechanisms that may enhance equity across different institutional settings.

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**Usage of AI and software**

In certain cases, artificial intelligence (AI), namely, https://chatgpt.com/, was used to verify the language's accuracy. However, no content in this paper was generated via AI.

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**Data availability**

Since the number of sample school are few, sharing the data may expose the confidentiality and privacy of the schools. Hence, the data is not available. However, the analysis outputs are available upon request from the first author. This paper is a part of a thesis conducted at the University Putra Malaysia.

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