

RESEARCH ARTICLE OPEN ACCESS

Residential Colleges as Equalizers for Sustainable Development? Examining Impacts on Sustainable Education and Equity Across Gender and SES

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Received: 8 July 2025 | **Revised:** 4 August 2025 | **Accepted:** 14 August 2025

Funding: The authors received no specific funding for this work.

Keywords: equity | gender | residential college | socioeconomic status | sustainable development | sustainable education

ABSTRACT

Equal access to quality education, both a fundamental human right and an economic cornerstone, has long been enshrined as the United Nations' Fourth Sustainable Development Goal 4 (SDG4). However, disparities in gender and socioeconomic status (SES) hinder its realization. Although residential colleges (RCs) in public universities have proven to be effective, research on RCs in private universities in China is still greatly lacking. Using univariate tests first and then multivariate regression analysis, this study compared RC and non-RC students in public and private universities and found that the fairness of admission to private institutions is poor, but all RCs significantly narrowed the academic gap among students from different social classes, and gender and RC status did not affect grades. Consequently, RCs are effective in reducing academic inequalities in that they give priority to providing equitable educational opportunity for individuals from poorer socioeconomic backgrounds. This is essential for promoting sustainable development in education.

1 | Introduction

Higher education is expanding rapidly worldwide, creating economic and academic challenges that are driving a shift toward privatization to efficiently meet the needs of a larger, more diverse student population (Carvalho et al. 2023; Lahmandi-Ayed et al. 2020). As part of this trend, concerns are rising as to whether these increased choices in tertiary education, in both public and private sectors, have fostered greater socioeconomic equality and contributed to sustainable education (Ilie et al. 2021).

Social science research on the impact private universities have on educational access and equality for less privileged

students can be viewed from two distinct perspectives. On one hand, an increase in educational opportunities, offered by both public and private institutions, naturally translates to more opportunities for students from low-income backgrounds (Marginson 2018). Proponents of this view contend that the expansion of tertiary education, regardless of the sector, acts as a catalyst for social mobility by providing more opportunities for all. On the other hand, critics assert that enrolment in higher education is still significantly affected by social inequality. Tertiary education has long and always been a privilege for the rich as they have better access to secondary education and the financial means to pay for it (Van den Broeck et al. 2023). This early advantage makes them more likely to afford higher education and succeed in it. What is

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more, the proliferation of private universities, in particular, could exacerbate inequality, because these institutions tend to offer poor quality education at a higher cost, which can disadvantage students from less privileged circumstances (Ilie et al. 2021).

In essence, while some see the expansion of universities as a means to enhance educational equality, others warn that this growth could inadvertently widen the gap between the rich and the poor, with the latter facing barriers both to entry and to quality education due to financial constraints. This argument underscores the complexity of the issue in the specific policy context and education system; then the need for a new approach to addressing learning disparities.

Ideally, an exemplary tertiary education system, be it public or private, should ensure that access to “educational potential” is not contingent upon one’s socioeconomic status (SES) (Alam and Forhad 2022), upholding the overarching purpose and objectives of higher education. Government-led equality initiatives often serve to boost overall participation in quality education, especially for disadvantaged groups (Ilie et al. 2021). On a global scale, numerous reforms and initiatives have been put into place to tackle educational inequality, with a range of outcomes emerging over time (Tomaszewski et al. 2024).

Against this backdrop, residential colleges (RCs) have been established with the intention to provide students with a learning experience that extends beyond the traditional classroom setting, addressing some of the equality concerns associated with higher education (Hurtado et al. 2020). The definition of this term may vary from country to country. Numerous scholars emphasize that an inclusive environment and collaborative interaction between faculty and peers are key components of living-learning programs, explicitly linked to a residential component (Dahl et al. 2020; Hurtado et al. 2020). The establishment of RCs with their focus on supporting development without regard to SES also falls in line with the United Nations’ Sustainable Development Goal 4 (SDG4). It aims to foster education quality and equality, including developing plans and system frameworks that fairly support national development (Costa et al. 2023; Gui and Alam 2024).

According to Kuh’s (2009) engagement theory, education institutions have the capacity to design and implement curricula and cocurricular activities that significantly boost students’ academic performance. A substantial body of empirical research has explored the institutional impact of RC on students’ academic performance and personal development, with findings indicating that RCs can play a significantly positive role (Baker and Allen 2021; Golde and Pribbenow 2000). RCs have been shown to positively influence various educational outcomes such as learning, cognitive development, attitudes, and grades (Golde and Pribbenow 2000). Research by Tompsett and Knoester (2023) suggests that students in schools with supportive environments tend to perform better academically, even when compared to peers from various socioeconomic backgrounds. Moreover, comparative studies indicate that RCs in public universities are, particularly, effective at reducing the performance gap between students from different socioeconomic strata (Gui and Alam 2024).

However, it is also observed that while RCs in public universities have the potential to contribute to equality in education, they do not necessarily reach students from all segments of society, particularly, those from lower SES. The recent study by Gui and Alam (2024) further emphasizes that while public RCs can enhance academic performance among students from diverse socioeconomic backgrounds, the challenge remains to ensure that these opportunities are accessible to all, regardless of their SES. The concern is that if only advantaged students benefit from RCs and if students from lower-status backgrounds encounter barriers to accessing these resources, then RCs could impede instead of promoting progress toward sustainable education and the fulfillment of SDG4, which is a key focus of current educational discourse.

Furthermore, only a limited amount of empirical studies has explored the relationship between RCs, SES within both public and private higher education sectors. In the existing research, there are contradictory conclusions. While some analyses have indicated that the link between SES and academic success can vary with the school environment, others have not detected a direct correlation between these factors (Alam and Forhad 2022; Holzer et al. 2025). This discrepancy may be due to the differences in the methodologies, definitions, and study designs that have been employed. Also, it is still not clear if private RCs offer equal opportunities to individuals from different SES groups and whether they can help to bridge the gap caused by socioeconomic disparities.

In addition, research conducted globally among students across various education levels has consistently identified a notable gender discrepancy (Beaulieu et al. 2021; Wrigley-Asante et al. 2023). Crowther and Briant (2022) noted that universities continue to both reflect and reinforce gender distinctions. However, some research indicates that gender differences in academic achievement across various levels show mixed or ambiguous results, and universities can be powerful institutions for promoting gender equality, diversity, and inclusion (Marcus 2018). For this reason, it is important to explore whether gender differences exist within the RC system in a specific context.

To advance the understanding of how RCs can contribute to sustainable education goals despite varieties in gender and SES, it is essential to conduct comparative studies between female and male RC and non-RC participants in private and public universities. This would involve assessing: first, their impact on students from different gender and socioeconomic backgrounds and second, their effectiveness in promoting educational equality and quality. The ultimate goal is to ensure that all students, regardless of their gender and SES, have access to high-quality education and the opportunity to succeed academically.

Therefore, the primary objective of this study is to examine the impact of RCs on reducing educational disparities in access and academic achievement. This research is situated in China, a country with a diverse and expansive higher education system (Gui and Alam 2024). Since their introduction in 2005, RCs have been gradually developed as part of China’s broader efforts to expand access to higher education. However, the effectiveness of these programs in promoting equal educational opportunities

and academic achievement for all students remains underexplored in practice.

To address this gap, the study employs two key approaches. First, a quasi-experimental design will be used to assess the influence of SES on students' access to and performance in higher education. Second, a comparative analysis will investigate differences in academic outcomes by gender and by RC participation, comparing students in both public and private university settings. This multidimensional approach aims to uncover whether RCs can serve as equitable, inclusive ecosystems that promote academic success across diverse student populations.

Enhancing the comprehension of the interplay between these factors will provide valuable insights into the contributions of RCs in private tertiary institutions in fostering educational equity and advancing sustainability. This effort will also enrich the existing body of knowledge on tertiary education reform. To accomplish this, this study will address the following research questions (RQs):

RQ1. *How does SES influence access to RCs in both public and private schools?*

RQ2. *Does academic performance vary between male and female students participating in RCs, and between students who participate in RCs and those who do not, in both kinds of schools?*

RQ3. *Do RCs mitigate or exacerbate academic disparities among different SES groups in both kinds of schools?*

RQ4. *Are RCs a significant factor in terms of advancing sustainable education at the tertiary education level?*

After identifying the research background, gaps, objectives, and problems, the literature review will be presented, followed by a discussion of the research method. The subsequent sections will detail the findings, discussion, and broader implications of the study before concluding with the final remarks.

2 | Literature Review and Hypothesis Development

This section commences with an explanation of sustainable education and then emphasizes the role of RC in education. Subsequently, a section is dedicated to discussing the inequalities arising from SES. Finally, the possibility of how RCs play a significant role in sustainable education is described, and the hypothesis for this study is developed based on existing literature.

2.1 | Sustainable Education

EFA (education for all) was a United Nations' (UN) foundational mission for education. This mandate requires that nations provide equal access to education to all children, irrespective of their gender, race, ethnicity, or SES (Alam 2023). In 2015, the UN officially launched the 17 goals that stemmed from the development agenda known as the SDGs (Allen et al. 2021). Of these, SDG 4—sustainable education—focuses on ensuring

inclusive and equitable quality education for all and fostering lifelong learning opportunities (Costa et al. 2023). The term “sustainable education” describes the dissemination of knowledge that guarantees balanced national growth, which includes social and economic advancement as well as an understanding of human needs (Sterling 2001). For the first time, SDG4 takes “quality”, “inclusion”, “equity” and “lifelong learning” as core dimensions, emphasizing that education is not only a “tool for skills transfer” but also a “cornerstone for achieving the all-round development of people and promoting social equity.” The proposal of SDG4 has established a unified goal and action that are coordinated for global education governance (Alam 2023). Moreover, sustainable education encompasses programs, institutional frameworks, and strategies aimed at promoting fairness in education (Alam 2023).

The quality of a nation's education system, particularly, at the university level, plays a critical role in shaping its cultural and social development. As highlighted by previous research, higher education significantly influences a country's progress in these domains (OECD 2020). In recent years, universities have been increasingly tasked with advancing sustainable development by formulating policies and strategies that promote sustainable practices. These efforts encompass areas such as sustainable food production, green procurement, renewable energy use, recycling, and the integration of sustainability themes into teaching and research (Allen et al. 2021). The UN further emphasizes the importance of collaboration between educational institutions and various sectors of society—including both public and private actors—to embed sustainability and foster a more sustainable future. In response to rising public awareness of sustainability issues, universities worldwide are promoting sustainable education through instruction, scholarly research, community engagement, and campus operations (Alam 2023). Within this context, RCs—an innovative model of higher education reform—warrant closer examination for their potential to foster inclusive, supportive educational environments and to advance the implementation of sustainable education principles.

2.2 | Impact of SES on Education

A crucial theme in education is the unequal distribution of learning results and opportunities among students, mirroring the broader inequalities in society (Lee 2025). This inequality in society is captured by disparities in the “social standing or class of an individual or group,” commonly referred to as SES (Tomaszewski et al. 2025). It is typically gauged by factors such as parents' level of education, occupation, and household income (Munir et al. 2023). Various sociological theories have been formulated to understand how SES can enable the perpetuation of privilege across generations (Tompsett and Knoester 2023). By studying the impact of SES in education, educators and policy-makers can pinpoint inequalities in access to quality education, resources, and support services that may favor students from higher SES backgrounds in order to develop targeted interventions aimed at leveling the playing field.

Sit (2024) has categorized educational inequality into two primary dimensions: access and achievement. Typically, students from higher SES backgrounds are found to achieve better

academic results due to their increased access to resources and greater levels of engagement compared to their counterparts from lower SES backgrounds (Tompsett and Knoester 2023). There is a need to expand academic success opportunities for individuals from disadvantaged backgrounds and to promote education as part of sustainable development efforts (Gui and Alam 2024).

Previous studies extensively reported the relationship between SES and students' educational access and achievement (Tomaszewski et al. 2025). However, there is limited investigation into whether this relationship has changed over time within education systems since many private institutions were established in addition to the public ones (Alam 2023). Numerous regulations were stipulated to increase opportunities and to reduce the disparity in learning outcomes between students from high and low SES backgrounds (Munir et al. 2023). There remains, however, a scarcity of straightforward measurable indicators for these efforts. Aiming to test if RCs can be one such indicator, this study addresses a significant gap in the literature. Given the aforementioned outcomes, the following hypothesis is proposed:

Hypothesis 1. *SES influences access to RCs in universities within both public and private schools.*

2.3 | Impact of Gender on Education

Scholars, policymakers, and professionals have observed and generally agree on the socially created disparities between genders and their significant impacts on individuals' lives (Beaulieu et al. 2021; Meneses et al. 2025). Gender is recognized as a factor influencing subject and course selection, as well as access to education institutions. It is frequently considered in analyses related to social class and other forms of social marginalization, such as ethnicity (Tsaousis and Alghamdi 2023).

When gender is emphasized, it is often addressed in a limited way. Specifically, studies conducted worldwide among students at different educational levels have consistently revealed a significant gender gap in academic achievement (Alasqah 2022; Meneses et al. 2025). For example, several studies indicate that females tend to excel in language-related subjects (e.g., Workman and Heyder 2020) and verbal tests, while males often perform better in STEM fields and visuospatial tests (e.g., Armah et al. 2021).

However, despite strong evidence on the impact of various personal and contextual factors on academic performance, the role of gender remains a topic of growing scientific interest because the findings are inconsistent. For instance, studies have shown no substantial gender differences in students' academic performance. In their meta-analysis, Else-Quest et al. (2010) discovered minimal gender differences in standardized mathematics test scores. Similarly, Goni et al. (2015) detected no significant gender difference in academic performance in a sample of college-going students.

Due to possible inconsistencies in the findings on the impact of gender in education, it is crucial to acknowledge the complexity of gender dynamics in specific educational settings. It is also

important to explore how they interact with other variables to shape academic outcomes. Following the argument made above, the next hypothesis is put forward:

Hypothesis 2a. *There is a difference in academic performance between female and male RC peers in two types of schools.*

2.4 | Role of RCs in Education

Disparities in education remain a significant barrier to achieving sustainability worldwide, despite numerous efforts aimed at addressing these issues (Alam 2023). International research indicates that RCs emerge as a distinctive strategy for enhancing equity and quality in tertiary education (Gui and Alam 2024). RCs are communities created within universities, where students from various socioeconomic backgrounds reside in close proximity and engage in extracurricular activities under the mentorship of faculty members (Buell et al. 2017). These colleges emphasize four key aspects: infrastructure, faculty-student interaction, peer communication, and the extracurricular environment. They are all designed to foster a supportive atmosphere within the institution, both inside and outside the classroom (Golde and Pribbenow 2000; Gui and Alam 2024).

Kuh's engagement theory emphasizes the impact of educational institutions on students' academic outcomes. This idea is further supported by Buell et al. (2017), who assert that students in supportive school environments tend to achieve higher academic outcomes compared to their peers, irrespective of their SES. Consequently, by fostering student engagement, RCs emerge as a strategy to enhance academic performance and foster quality development, a concept substantiated by extensive research (Inkelas et al. 2007; Buell et al. 2017). Based on this argument, the following hypothesis is posited:

Hypothesis 2b. *There is a difference in academic performance between RC and non-RC peers in two types of schools.*

Furthermore, SES is a significant predictor of educational quality, including academic achievement, according to a number of studies (Coleman 1988; Tompsett and Knoester 2023). The scholars argued that schools with a higher proportion of students from higher socioeconomic backgrounds typically get better results than the national average (Perry 2012; Alam and Forhad 2022). Although the relationship between SES and student outcomes is well established in the literature, few analyses have examined the effect of SES in both private and public RCs.

Moreover, it has been recognized that schools and educational institutions are useful instruments for reducing the influence of SES on academic performance (Alam 2023). All entities (public, private) of education are obliged to be homogeneous and unified to all students (Gui and Alam 2024). However, the social reproduction theory presents a contrasting perspective, suggesting that the educational system may perpetuate socioeconomic disparities; essentially, it passes on advantages and disadvantages from one generation to the next (Rodríguez-Rocha 2021). Some studies on RCs have echoed this viewpoint, indicating that while RCs in public universities can help narrow academic disparities among students from different SES groups, they fall short of

ensuring participation from students across all SES levels (Gui and Alam 2024). This highlights the complexity of addressing educational disparities and the need for a multifaceted approach to promoting equity in higher education.

Given the lack of attention being paid to whether private RCs have the same impact as public ones; and considering the implications of social reproduction theory, the following hypotheses are proposed.

Hypothesis 3a. *There is a significant relationship between SES and students' academic performance in two types of schools.*

Hypothesis 3b. *RC diminishes the moderating impact of socioeconomic status on students' academic performance in two types of schools.*

Having formulated the hypotheses, the methodology, including the research background on this topic, is outlined in more detail below.

3 | Methodology

This study employed a quantitative, comparative approach to examine the impact of SES disparities on educational access and performance among RC students in China, comparing male and female RC students across university types to identify any significant gender-based differences. It also assessed the effectiveness of RC programs in reducing SES disparities.

3.1 | Setting of the Study

Referring to the research background, it is crucial to highlight the status quo of higher education and RCs in China. Higher education in China is making a huge contribution to the nation's economy. Currently, 47.63 million students are enrolled in its tertiary institutions, and there has been a consistent increase in both public and private universities (MOE 2024). The Ministry of Education reports that from 2000 to 2023, the count of private universities in China grew from 43 to 789, and public universities increased from 1041 to 3074 (MOE 2024). It should be noted that Chinese universities are classified into four distinct categories: teaching and vocational institutions, research-focused universities, and universities that emphasize both research and teaching (Gui and Alam 2024). Notably, no private universities are categorized within the latter two groups, indicating the possible unique nature of private universities.

Sadly, similar to many other nations, the expansion of access to higher education has not guaranteed an equitable distribution of higher education institutions (HEIs) (Van den Broeck et al. 2023). Despite China's higher education sector opening up new learning opportunities (Dong et al. 2022), students from higher SES backgrounds still maintain an advantage in gaining admission to both public and private institutions (Munir et al. 2023). Studies have also indicated that the surge in enrollment may have seriously undermined the quality of talent, with SES remaining a significant barrier to achieving academic success (Tompsett and Knoester 2023).

The term "RC" carries different meanings from region to region in China. It has emerged as a strategic initiative to address educational quality issues arising from the rapid expansion of higher education. Chinese RCs are formally organized institutions responsible for overseeing student affairs and are administratively integrated with all campus entities. They are committed to promoting the holistic development of university students, with a particular focus on ideological development (Gui and Alam 2024; Li and Xiang 2020).

In 2005, a select group of prestigious public universities launched RC pilot programs. With government support, RC programs in China expanded rapidly, growing from 5 in 2005 to 97 by 2020 (Gong et al. 2021). RC institutions now include both undergraduate and vocational schools, covering both private and public entities. However, little comparative research has been conducted to determine whether this government-supported system effectively reduces educational disparities and promotes sustainable educational development, indicating a need for further study.

3.2 | Sampling and Sample Size

Based on the field data in the RC Development Report (Gong et al. 2021), this research focuses on 59 universities that implemented RCs by 2020. It is based on the fact that a standard 4- or 5-year college program keeps participants within all different school levels. Moreover, in these target institutions, only a segment of the student population in these schools participated in their RC programs while others did not, which makes a comparative analysis possible. Among these universities, 7 are private and the other 52 are public.

To enhance the applicability and credibility of this research, the target HEIs are categorized according to their geographic districts through a multi-stage approach. First, considering the budgetary and time constraints, a purposive sampling approach was adopted to determine the sample size on RC in different regions. Then, within each specified region, a random sampling method was employed to ensure that every institution had an equal chance of being selected, thereby reflecting a variety of sizes, types, and locations. After identifying the sample HEIs, the sample sizes for RC and non-RC participants were calculated using the following formula (Krejcie and Morgan 1970):

$$n = N \times Z^2 \times P \times (1 - P) / e^2 \div [N - 1 + Z^2 \times P \times (1 - P) / e^2]$$

With a total of 6940 RC students in the sample universities, the sample size was set at 606. A proportionate stratified sampling technique was then applied to select samples from each university. The RC sample sizes were 131, 114, and 92 from private universities in the east, center, and west, and 122, 83, and 64 from public universities in these three regions, respectively (Table 1). An equal number of non-RC peers from the same institutions was selected for comparative analysis.

3.3 | Instrument and Data Collection

The survey used in this study was validated by prior research and designed to collect primary data. It is divided into three

TABLE 1 | Sample size.

University type	District	Selected universities	Total RC students	Selected RC students	Selected non-RC students
Private	Eastern	1	1600	130	130
	Central	1	1350	110	110
	Western	1	1150	93	93
Public	Eastern	1	1570	128	128
	Central	1	1010	82	82
	Western	1	820	67	67
Total		6	7500	610	610

Note: Authors' extraction.

main sections. Part one gathers basic demographic information such as gender and ethnicity. Part two examines SES data across five factors: parental education, occupation, and family income. Part three focuses on four aspects of the college living experience (CLE): extracurricular involvement, communication with faculty, communication with peers, and perceptions of school infrastructure (Inkelas et al. 2007). This section contains 28 items across four components, with responses rated on a 5-point Likert scale. Participants' academic achievement, measured by cumulative grade point average (CGPA), was obtained from the academic offices of the participating institutions.

A pilot study was conducted to test the reliability and validity of the instrument with a group of 60 RC and non-RC students outside the main sample. The internal consistency coefficient (Cronbach's alpha) was calculated ($\alpha=0.948$), confirming the measure's reliability. Subsequently, exploratory factor analysis (EFA) was performed using principal component analysis (PCA) with varimax rotation. The KMO value was 0.799, and Bartlett's test was significant at below 0.001. Four factors were extracted based on Eigenvalues greater than 1.00, accounting for 94.902% of the total variance. The EFA results confirm the instrument's validity.

After identifying the instrument's reliability and validity, these data were conducted online after the participants voluntarily gave their consent. Participants fully understood that they had the right to withdraw from the study at any time and were assured that their data would be used solely for research purposes. The data collection period lasted for approximately 4 months. The response rate was adequate, reaching 90.6%, with a total of 1106 valid responses gathered after eliminating questionnaires with excessive missing data. Table 2 offers the demographic details that captured the characteristics of both RC and non-RC students across various districts in China, encompassing both public and private education institutions.

Furthermore, to ensure sample quality and representativeness, the outlier detection and normality tests on the multivariate continuous data (SES, CLE, and CGPA) were conducted. Boxplot analysis revealed no outliers, indicating a stable and well-distributed dataset. The skewness (quantifying distributional symmetry) and kurtosis (measuring distributional peakedness)

were assessed. As shown in Table 3, the absolute skewness values for all three variables were below the threshold of 2, demonstrating acceptable symmetry. The kurtosis values fell within the -4 to 4 range, suggesting approximately normal distributional peaks and meeting the criteria for substantial normality (Kim 2013). These results collectively confirm the high quality of the participant data.

3.4 | Data Analysis

Four RQs are explored. The first question assesses how SES influences access to private versus public RCs in China. A descriptive comparative analysis will be conducted to address this question (RQ1). Participants will be grouped into various SES categories, and graphs of frequencies will be utilized to visualize the results. Second, it is asked whether RC can play a role in academic performance (RQ2); an independent samples *t* test will be conducted to compare the academic performance of female and male RC students, and RC and non-RC students.

RQ3 aims to scrutinize the link between RC, SES, and disparities in academic achievement. Hierarchical multiple regression analyses will be executed for this purpose, with CGPA as the dependent variable and demographic details—namely gender, ethnicity, and region—serving as control variables. Notably, the interaction term encompassing RC and SES will be integrated into the multiple regression model to uncover how RC might mediate the academic performance disparity influenced by SES. The relationship between RC and the dependent variable (CGPA), excluding the influences of SES and other demographic factors, is established through the use of hierarchical regression.

The last RQ4 pertains to identifying effective strategies for sustainable development in education, informed by the previous analyses. Statistical analysis will be conducted utilizing SPSS software, version 28.

4 | Results

This section of the paper presents the results and analysis together before moving on to the discussion and conclusions. The first two subsections are dedicated to addressing RQ1 and RQ2.

TABLE 2 | Respondents' demographic data.

Data		Private		Public	
		Number	Percentage	Number	Percentage
Type	RC	325	52.7	259	53.0
	Non-RC	292	47.3	230	47.0
District	Eastern	247	40.0	231	47.2
	Central	189	30.6	142	29.1
	Western	181	29.3	116	23.7
Gender	Male	389	63.0	206	42.1
	Female	228	37.0	283	57.9
Ethnicity	Han	530	85.9	405	82.8
	Minorities	87	14.1	84	17.2
Region	Rural	276	44.7	236	48.3
	Urban	341	55.3	253	51.7
Grade	First	89	14.4	201	41.1
	Second	123	19.9	108	22.1
	Third	255	41.3	92	18.8
	Fourth or above	150	24.3	88	18.0
Major	Natural science	230	37.3	104	21.3
	Social science	313	50.7	199	40.7
	Human culture	74	12.0	186	38.0

Note: $n = 1106$. Authors' extraction.

TABLE 3 | Test of normality.

		Statistic	SE
CGPA	Mean	3.521	0.020
	Variance	0.447	
	SD	0.667	
	Skewness	−1.614	0.074
	Kurtosis	2.205	0.147
SES	Mean	23.624	0.05238
	Variance	89.018	
	SD	9.435	
	Skewness	−0.041	0.074
	Kurtosis	−1.166	0.147
CLE	Mean	10.853	3.408
	Variance	11.616	
	SD	3.408	
	Skewness	−0.083	0.074
	Kurtosis	−1.048	0.147

Note: Authors' extraction.

Subsequently, it focuses on [RQ3](#), while the last subsection is reserved for discussing [RQ4](#).

4.1 | Impact of SES on Enrollment in Public and Private HEIs

Two steps were followed to address [RQ1](#) regarding the impact of SES on the education access gap between public and private RCs and to validate Hypothesis 1. The initial steps involved utilizing SES indicators. A comprehensive SES index was derived using a regression equation, which was then categorized into three levels: high, medium, and low (Gui and Alam 2024). Subsequently, a comparative analysis of SES across three strata was conducted between public and private institutions, leveraging demographic and personal income statistics from various socioeconomic groups, as reported by the National Bureau of Statistics of China (NBSC 2023).

The research demonstrates that access to public and private RCs in Chinese HEIs is still influenced by SES. As depicted in Figure 1, national statistics reveal that a mere 2.9% of individuals belong to the upper social class, with the majority categorized as middle (48.9%) or low SES (48.2%). Drawing on national data as a reference point, the distribution of students from middle SES level is in both private (36.3%) and

public (41.7%). Students at the intermediate SES level make up the largest percentage for national, public, and private data. However, there are noteworthy discrepancies in the representation of high and low SES groups within RCs. In private RCs, the proportion of high SES students was higher by 34.9%, while in public RCs, this figure was 19.0%. Conversely, when compared with the baseline, the number of low SES students in private RCs was 22.3% short, and that number was 11.8% in public RCs. Consequently, Hypothesis 1, which posits a link between SES and access to both public and private RCs, is accepted. The finding may imply that individuals from affluent socioeconomic backgrounds possess a competitive edge when it comes to securing places in RCs, and this advantage appears to be amplified within the private sector.

4.2 | Academic Achievement Comparison

The univariate test, specifically an independent samples *t* test, was conducted to address RQ2 and test Hypotheses 2a and 2b, examining academic performance differences between male and female RC participants and between RC and non-RC counterparts. As shown in Table 4, the results indicated no significant difference in academic performance between RC and non-RC students ($t = -1.829$, $p > 0.05$) or between male and female students ($t = 1.514$, $p > 0.05$) in private universities. The results are the same in public universities between RC and non-RC students ($t = 0.078$, $p > 0.05$) or between male and female students ($t = 0.170$, $p > 0.05$). Consequently, Hypotheses 2a and 2b were refuted, indicating no significant difference in academic

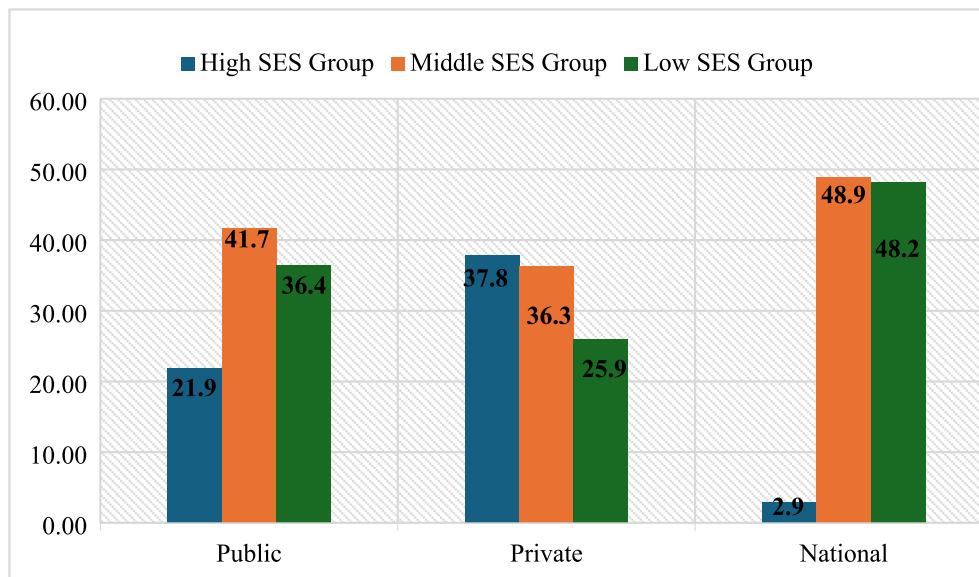


FIGURE 1 | Proportion of respondents from the three distinct SES strata. Authors' extraction.

TABLE 4 | Academic performance comparison of various student groups.

Type	Group	<i>n</i>	Mean	SD	<i>t</i>	<i>p</i>
Private	RC students	325	3.583	0.606	-1.829	0.068
	Non-RC students	292	3.674	0.637		
	Male RC students	295	3.583	0.599	1.514	0.981
	Female RC students	30	3.580	0.677		
Public	RC students	259	3.390	0.645	0.078	0.938
	Non-RC students	230	3.385	0.762		
	Male RC students	82	3.400	0.515	0.170	0.865
	Female RC students	177	3.385	0.698		

Note: Authors' extraction.

Abbreviation: RC = residential college.

performance between male and female RC students or between RC and non-RC peers in both private and public HEIs.

4.3 | RC'S Effect on Academic Disparity due to SES

The multivariate hierarchical regression analysis was performed to address RQ3 and evaluate Hypotheses 3a and 3b) concerning the impact of SES on academic performance and the moderating effect of RCs. The regression model was structured with three sequential blocks of variables: (1) first block: control variables such as school type, district, gender, ethnicity, family region, grade, and major; (2) second block: CLE and SES variables; (3) third block: interaction term SES×RC. Nominal variables were recoded into dummy variables for the analysis. The findings are presented in Table 5.

In Block 1, university type, central universities, gender and major positively influence academic performance. In Block 2, after excluding the interference of these control variables, SES ($\beta=0.019$, $p<0.01$) significantly predict academic performance. Hence, Hypothesis 3a is accepted because the analysis showed SES positively impacts academic performance. In Block 3, the interaction term SES×RC significantly predicts academic performance ($\beta=-0.019$, $p<0.01$), with a negative coefficient confirming Hypothesis 3b that RCs mitigate the correlation between SES and academic performance.

4.4 | RC'S Effect on Sustainable Education

RQ4 aims to explore the efficacy of RCs in both public and private universities based on the previous findings. RCs are established in universities in China to improve the quality of students' education. The results suggest that while students from different socioeconomic backgrounds can opt to join RCs, not all students with the advantages of a high SES background are more likely to participate compared to those from a low SES background. This demonstrates that SES still influences access disparities within some public and private HEIs (Munir et al. 2023).

Thus, RCs can help promote quality equity in education, suggesting that their residential programs may be important for creating a fairer and more inclusive learning environment within Chinese higher education. That being said, both public and private RCs have been found to minimize the influence and role of SES in academic achievement. Based on this assertion, it can be stated that RCs positively contribute to narrowing academic gaps (Gui and Alam 2024). This finding enhances our understanding of the intricate interplay among SES, RC, and sustainable development. By demonstrating that residential programs in Chinese universities can play a crucial role in fostering a more inclusive educational setting for students and equalizing opportunities, it is safe to conclude that RCs can serve as an option for advancing educational equity within Chinese higher education.

TABLE 5 | Correlations between SES, RC, and academic performance.

Variables		Block 1	Block 2	Block3
University	Private	0.220**	0.116*	0.127*
District	Central	0.185**	0.157*	0.175*
	Western	0.089	0.110*	0.122*
Gender	Male	0.206**	0.239**	0.236**
Ethnicity	Han	0.048	0.003	-0.001
Region	Urban	0.098	-0.137*	-0.129*
Grade	Second	0.018	0.014	0.019
	Third	0.121	0.087	0.104
	Fourth/above	0.175	0.096	0.119
Major	Social science	-0.075	-0.103	-0.093
	Human culture	0.220*	0.156*	0.159*
	CLE		0.067	0.088*
	SES		0.019**	0.028**
	SES×RC			-0.019**
	R	0.279	0.337	0.349
	ΔR^2	0.078	0.114	0.122
	F	8.402	10.771	10.789

Note: Authors' extraction.

Abbreviations: CLE = college living experience, DV = academic performance (CGPA), RC = residential college, SES = socioeconomic status.

* $p<0.05$.

** $p<0.01$.

5 | Discussion

This study tries to illuminate the essential correlation among gender, SES, RC, and educational disparities in a developing country that has a highly developed education system. The findings will enrich our understanding of the adaptability of RC as a practical implementation to facilitate education equality and quality in a non-Western context.

The results suggest that despite the increased enrollment in Chinese RCs, public or private, access to tertiary education remains unequal across various socioeconomic levels. Families with higher SES have a greater number of students enrolling in both public and private RCs, which underscores the enduring influence of SES on access to RCs, irrespective of their public or private nature (Gui and Alam 2024). Emphasized here is that SES continues to function as a pivotal factor in education research (Tompsett and Knoester 2023). While it may seem that students from diverse SES groups have equal opportunities to engage in RCs in China, the reality is that despite government efforts, RCs in piloting programs still disproportionately benefit students from affluent SES backgrounds.

In addition, this study provides empirical evidence that there is no statistically significant relationship between gender and academic performance in both public and private RCs. It highlights the intricate nature of gender dynamics within specific educational environments (Else-Quest et al. 2010; Goni et al. 2015) and indicates that gender disparity does not significantly affect the academic performance of RC students.

Moreover, previous national studies, such as those by Inkelas et al. (2007), have documented significant differences in various dimensions and outcomes between students in RCs and their counterparts in comparison groups. Existing research has consistently demonstrated a positive association between RC participation and students' academic achievement (Golde and Pribbenow 2000). However, it is critical to acknowledge that RCs may vary substantially in their objectives, scale, contextual factors, and program structures, potentially leading to heterogeneous effects on student learning outcomes (Buell et al. 2017). Consistent with prior findings indicating a positive link between RC engagement and academic performance (Dahl et al. 2020), the current study reveals a statistically significant positive relationship between RC participation and academic achievement.

Additionally, students from higher socioeconomic backgrounds consistently outperform their counterparts from lower socioeconomic backgrounds, although the strength of this correlation varies across different contexts (Gui and Alam 2024). This study supports the widely accepted view that SES is a key factor influencing academic performance within the context of RCs. Families with privileged socioeconomic circumstances generally have the means to provide a rich home learning environment, laying a strong foundation for academic success, supported by their stable employment and higher qualifications (Sirin 2005; Tompsett and Knoester 2023). This suggests that SES is a significant contributor to educational disparities and challenges to achieving educational equity.

This study expands on this theme by examining how RCs might help bridge the academic performance gap linked to SES and advance sustainable education. Alam (2023) underscores the significance of an informed education system in dismantling biases and ensuring that every individual, regardless of their SES, has equitable access to high-quality education. Given the well-established link between SES and academic performance—where students from higher socioeconomic backgrounds often perform better academically, even within RCs (Alam and Forhad 2022)—our findings strongly suggest that RCs can help mitigate these disparities, especially in private sector RCs. These results align with Gui and Alam (2024) findings on public RCs.

This insight significantly bolsters our comprehension of the intricate dynamics involving SES, RCs, and education outcomes. RCs have the potential to act as agents of greater equality in education, illustrating that, in Chinese universities, their residential programs may play a crucial role in leveling the playing field and fostering a more inclusive learning environment. In China, RCs are, particularly, well-positioned to support sustainable education practices. To fully leverage RCs' potential in this area, it is essential to deepen our understanding of how to optimize their impact.

6 | Implications

The implications are covered in this section, which contributes to both theoretical perspectives on education disparities and practical considerations for educators, policymakers, and institutions aiming to enhance equality and quality.

6.1 | Theoretical Implications

The study extends its theoretical scope to educational frameworks, including student engagement theory, social reproduction theory, and others. These theories highlight the role of the institutional environment in shaping student academic achievement. This underscores the interconnectedness of various constructs and emphasizes the multifaceted nature of RCs' influence on students' academic experiences. The theoretical implications extend beyond the immediate context of the study, providing a foundation for future research and theoretical development in the field of education studies. Additionally, the study delves into the fundamental human right of education, emphasizing its universal accessibility. Education inequality remains a constant and critical global challenge, spanning issues like access to schooling, dropout rates, and, most notably, variations or simply widening gaps in learning outcomes, each carrying unique consequences (Schmelkes 2021). By investigating the effects of RCs, this research sheds light on the influence of this model on students from diverse socioeconomic backgrounds.

Sequentially, this study constitutes a notable contribution to empirical research methodology in education. Leveraging national data from diverse regions across China, the research employs a comparative approach, utilizing established theories and statistical inference techniques. This research methodology presents an exemplar for scholars in the field, showcasing a comprehensive

and systematic approach to understanding complex educational phenomena. The study's design, data collection, and analysis methods can inspire researchers to employ similar strategies in evaluating other education policies and practices.

6.2 | Practical Implications

In addition to its theoretical implications, this study holds significant advantages for a diverse range of stakeholders, including the Chinese government, HEIs, faculties, parents, and students. The findings offer comprehensive and objective insights into the implementation of RCs, providing a solid foundation for decision-making and policy formulation.

First, the results of this study can serve as a crucial resource for policymakers and education administrators in China. A good understanding of the moderating effects of RCs makes it possible for better-informed decisions to be made regarding the allocation of resources. Policymakers can use these insights to identify specific groups of students that would benefit most from RC programs. Second, the findings empower school teachers and staff to take proactive measures that address the diverse needs of students from varying socioeconomic backgrounds. By recognizing the influence of SES, educators can implement interventions and support mechanisms that cater to the specific challenges faced by students with unprivileged family economic backgrounds. Third, the results of this study provide parents and students with a wealth of information to make informed decisions about education pathways. Understanding the positive aspects of RCs, such as the collaborative and inclusive environments they foster, enables parents and students to make well-informed choices when selecting universities and education programs. This implies that parents and students can consider RCs as a viable means to address and improve equality issues in education.

In summary, this study holds both theoretical and practical significance for education policy formulation, resource allocation, equity, learning improvement, and academic research. The insights derived from this paper are instrumental for enhancing the quality and efficiency of China's higher education system.

7 | Conclusions

This paper accentuates the persistent influence of SES on access for both private and public RCs and students' academic accomplishments. While this underscores the role of SES as a determining factor in academic outcomes, it also sheds light on the pivotal moderating effect exerted by RCs on the intricate relationship between SES and the college living environment, ultimately shaping the academic trajectory of students. It is crucial to acknowledge that RCs do not present a one-size-fits-all solution capable of instantly and dramatically transforming a student's academic journey. Instead, the study suggests that RCs play a substantial role in shaping the education landscape for students, particularly, in moderating the impact of SES and fostering positive CLEs. This nuanced understanding contributes to both theoretical perspectives on education disparities and

practical considerations for educators, policymakers, and institutions aiming to enhance equality and quality.

Although this study has both theoretical and practical implications, there are some limitations. First, future research could incorporate more variables, such as study time, learning motivation, and persistence, which may influence the results. Second, employing diverse research methods can enhance the depth and breadth of future research. This study mainly relied on quantitative methods, which may not be able to fully explore the intrinsic mechanism of the RC. Therefore, mixed methods—which means combining quantitative and qualitative research strategies—may provide a more comprehensive perspective for evaluating the effectiveness of the RC model. In addition, it will be of great significance to expand the sample scope so that the effectiveness of RC in promoting sustainable education in different countries can be evaluated. It is also valuable to conduct cross-national comparative analysis to explore the moderating role of RCs in educational equity, especially how they affect SES factors. Ultimately, future research can build upon this study and overcome the current limitations. However, the present study provides a more profound and sophisticated comprehension of how RC fosters educational equity.

In conclusion, educational equality has been a long-standing concern worldwide, and the UN strives to achieve this goal through its Sustainable Development Plan. However, SES remains a significant barrier to equality and undermines the sustainable development of education. Government-led equity projects aim to boost participation from socioeconomically disadvantaged groups and overall enrollment. In China, government policies and plans have promoted the development of RC with the aim of creating a superior learning environment for students. While these measures may not completely solve the problems of access to educational resources due to SES, RCs have significantly reduced academic disparities. Therefore, by creating an inclusive and supportive educational atmosphere, it provides an innovative reference for higher education talent cultivation model to facilitate sustainable education.

Author Contributions

All authors have contributed equally to all aspects of the production.

Acknowledgment

Open access publishing facilitated by Università degli Studi di Torino, as part of the Wiley - CRUI-CARE agreement.

Disclosure

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

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