Discover Sustainability

Research

Does socioeconomic status influence students' access to residential college and ameliorate performance discrepancies among them in China?

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Abstract

Education is one of the main prerequisites for a country making economic progress. A well-informed and well-functioning education system should be able to address most kinds of discrimination or privilege, ensuring that all people have equitable access to high quality education, regardless of their socioeconomic status (SES). It is noted that it cannot prevent every discrimination-related issue that arises. Residential colleges (RCs) have evolved over time in higher education. In this era of the United Nations' Sustainable Development Goals (SDGs), it is crucial to assess whether RCs genuinely promote equal access and good quality education. Focusing on China, this study investigates whether RCs contribute to education equality or simply serve individuals from privileged socioeconomic contexts. Primarily, employing the quantitative research methods, including descriptive and grouped regression analysis, this study analyzes data from 397 RC students nationwide. The results reveal that RCs are accessible to students from different SES backgrounds, but enrollment disparities persist based on SES. Furthermore, SES does not dictate the role of RCs in academic performance among different social groups; RCs help to narrow the performance discrepancy between students from various socioeconomic backgrounds. These findings underscore the constructive role of RCs in advancing sustainable education and provide valuable insights for decision-makers aiming to get RCs to reduce education disparities.

1 Introduction

Equitable access for every individual who requires education of a high quality to enhance their future employment opportunities has become one of the fundamental objectives of countries throughout the world [1]. Seventeen goals were targeted in 2015 by the United Nations for Sustainable Development Goals (SDGs), which aimed at tackling various environmental, social, and economic challenges globally [2]. Of these, the fourth SDG aspires to ensure equitable and inclusive high-quality education and promote everyone's lifelong learning opportunities [3]. Higher education plays a significant role in achieving a country's economic goals, contributing not only to research and teaching, but also to governance policies, social involvement, and collaborations among institutions [4]. Nevertheless, global efforts to ensure

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sustainable education encounter persistent challenges, including socioeconomic status (SES) and disparities in people's family backgrounds [5].

Theoretical and empirical evidence demonstrate that SES significantly influences students' participation in education and academic outcomes [6–8]. Individuals from poorer socioeconomic backgrounds tend to encounter evident setbacks, delays, and inequalities [5]. Those hailing from higher socioeconomic backgrounds generally enjoy greater access to education opportunities and resources, such as better school choices, homeschooling and academic assistance [9]. Conversely, individuals from low family socioeconomic circumstances often lack the proper resources, potentially hindering their participation and what they can achieve [7, 8]. Nevertheless, access to high-quality education is an equal right and should not restricted to particular individuals or groups in society [10]. Education is widely considered one of the most powerful instruments for breaking down social inequality and fostering countries' more sustainable development [11]. A well-functioning education system, including higher education provision for all, is critical in preventing any form of prejudice or privilege [9]. Specifically, higher education can help increase social class mobility by facilitating many underprivileged students to enter their chosen profession [12]. In most nations, enrollments in higher education are rapidly increasing, reflecting its now more socially inclusive nature, but it should be noted that education's influence on social mobility varies by country and across time [13].

RCs have a long history and are intimately associated with prestigious institutions such as Oxford, Cambridge, Harvard, and Yale [14, 15]. As unique learning and living communities in higher education institutions, RCs have played a vital role [16, 17]. The nature of RCs and their reforms have undergone continuous changes and refinement. By establishing seamless learning communities that enhance communication with faculty and peers, coordinate extracurricular activities, and create an inclusive environment, RCs can foster a highly productive atmosphere [16]. This helps students from various backgrounds to experience personal growth, engage in academic pursuits, and stimulate meaningful social relationships [17]. RCs are widely acknowledged as high-impact learning environments, significantly enhancing students' academic achievements and overall progress [18].

However, the question needs to be asked: does the development of RCs strengthen accessibility for individuals from diverse SES contexts, promote equality, and high-quality education? Should the RC system be characterized as 'sustainable,' aligning with the achievement of SDGs? This question is yet to be addressed in the literature. The following section outlines the research questions that aim to elucidate the objectives of this study.

1.1 Research gap, scope: objectives and questions

An abundance of research on the effectiveness of RCs has been published. Several theoretical and empirical studies indicate a positive impact of RCs on education engagement, academic achievement, and personal growth [16, 17, 19]. Moreover, many studies have consistently shown that SES is a significant predictor of academic performance [20–22]. The prevailing consensus suggests that SES has a significant positive relationship with academic performance [20, 23, 24]. At the same time, certain studies have concentrated on examining the contribution of education frameworks in tackling SES inequalities. As an illustration, one practical investigation [25] utilizing data across seven East Asian nations from the 2015 Program for International Student Assessment (PISA) revealed that the utilization of information and communications technology (ICT) does not play a role in the effect of SES on academic performance. In a research project carried out in Bangladesh, scholars [26] utilized both qualitative and quantitative analysis methods, revealing that engineering education does not effectively mediate the relationship between SES and students' professional progress. Nevertheless, education institutions can mitigate the growth of socioeconomic inequality through effective instruction in academic and other learning skills [27].

Regarding RCs, limited research has examined the SES as influencing students' access to and engagement these places, especially in the context of how higher education institutions achieve the SDGs [4]. Therefore, this research endeavors to fill this gap, focusing specifically on China as a case study. Upon identifying the gap in our knowledge and the scope of this study, the research objectives and questions are presented.

The primary goal of this paper is to investigate whether RCs in China contribute to balancing SES realities or if an advantaged SES determines enrollment for RCs. The detailed objectives are: firstly, mapping the status quo of RC students' SES in China; and secondly, examining how RCs in China narrow academic performance disparities between diverse SES tiers and the effects they have on sustainable education as a consequence. The following research questions will be answered to accomplish these objectives:

RQ1. What is the SES diversity of RC students in China?
RQ2. How do RCs in China narrow academic performance gaps between diverse SES groups?
RQ3. Do RCs matter regarding the support given to sustainable education?

The next section involves a review of the literature, followed sequentially by a justification and explanation of the study methodology. After presenting the findings and discussion, the final section will highlight the conclusion.

2 Literature review

This section initially investigates the literature on the correlation between SES and education. Subsequently, it examines the concept and historical development of RCs. The review of the relevant literature concludes with an exploration of the effectiveness of RCs, particularly with regard to sustainable education.

2.1 Socioeconomic status and education

SES, often conceptualized as a hierarchical status system determined by unequal access to social standing and economic resources, is commonly evaluated by family income, parents' education level and occupation [25, 28]. The correlation between education and SES is bidirectional, with each influencing the other [29]. Many studies have emphasized the role of SES in predicting education achievements [7, 11]. Students from higher socioeconomic backgrounds tend to achieve better academic outcomes, obtaining higher grades and experiencing more success. This is attributed to their enhanced access to resources and increased participation rates compared to their peers from lower socioeconomic backgrounds [23, 24]. Therefore, the hypothesis suggests that SES does have a significant impact on students' academic success.

Nevertheless, it is an essential right for students from various and often economically disadvantaged backgrounds to have a good education. Education serves to enhance individuals' human capital, offering a potential means to overcome and surpass socioeconomic disadvantages in numerous instances [1]. By opening avenues to superior social and standing income, individuals with high levels of schooling are better positioned to offset the negative impacts of a disadvantaged SES on their future professional trajectories [30]. Higher education, especially for persons from rural backgrounds, acts as an institutionalized pathway, providing an opportunity for people to become prominent in urban environments and attain upward mobility. [12]. Education contributes to improving individuals' SES and plays a crucial role in fostering sustainable economic and social development [1, 4].

2.2 Historical development of residential colleges

RCs represent self-contained communities within larger education institutions, fostering a diverse student population engaged in curricular and co-curricular programs or activities with the guidance of tutors [14]. In contrast to traditional dormitories, RCs distinguish themselves by prioritizing the seamless integration of students' academic, social, and living experiences. This fusion is achieved through enhanced engagement with both instructors and fellow students, coordinated study initiatives, and the building of a nurturing and inclusive residing climate [16, 31]. The medieval colleges of Cambridge and Oxford in the United Kingdom are where RCs originated, closely tied to the church, emphasizing the provision of scholars with residential spaces where they could live and study together [32]. The Oxbridge collegiate system served as a global model for educational institutions, influencing the implementation of RCs in numerous countries, such as the United States of America, China, Singapore, Australia, and beyond [18].

Moreover, the development and configuration of RCs have consistently changed to address the evolving requirements and expectations of both individuals and the broader society. RCs are commonly identified by four main features: residential setting, communication with instructors and peers, and active involvement in extracurricular programs or activities [31, 33]. RCs have transformed from traditional residential models to dynamic sites of academic and social fusion, which have become crucial aspects of the whole student journey in various universities throughout the world [14, 34].

2.3 Residential colleges and sustainable education

Numerous studies have explored how RCs contribute to advancing quality education by establishing an atmosphere that encourages meaningful interactions among students and faculty, both within and beyond the classroom [35, 36]. RCs enrich

the holistic college experience for students, cultivating a sense of belonging and comprehensive abilities by providing shared residing space and assistive academic initiatives [19]. Meanwhile, RCs offer customized professional tutorial support to enhance knowledge growth and boost learning success [17]. Some scholars indicated that RC students exhibit a stronger sense of social interaction or engagement, increased Grade-Point Averages (GPAs), and better academic achievement when compared to non-RC cohorts [37, 38]. Nevertheless, it is essential to identify the significance of the RC context, as the achievements of students are profoundly influenced by the learning programs and environments [36, 39].

In addition, university systems are recognized as potent means for lessening the influence of socioeconomic status on education performance [9, 22]. The Social Reproduction Theory presents an alternative perspective on education and the reproduction of inequality [40]. Devised by the sociologists Bourdieu and Passeron [41], this theory proposes that the education system can perpetuate prevailing economic and social disparities by passing on privileges and non-privileges from generation to generation. It questions the belief that equal enrollment opportunities in education, supported by educational institutions or government initiatives, can completely eradicate social disparities and inequalities [40, 42]. In doing so, this notion stimulates people to critically assess whether RCs predominantly cater to individuals with advantaged settings, reinforcing existing political hierarchies or socioeconomic status, or if they are truly devoted to attaining sustainable equality in the higher education system.

According to the aforementioned arguments, the hypotheses in this study are posited as follows:

H1 There is a significantly positive relationship between RCs in China and academic performance for students from diverse SES backgrounds.

H2 Differences in socioeconomic status do not affect the influence of RCs in China on academic performance. Additionally, RCs serve to narrow the academic performance gaps between various SES groups.

The research model is illustrated in Fig. 1 and it reflects the hypothesized relationships between the constructs.

3 Research context

This section elucidates the research background, providing subsequent justification for the suitability of the selected research design. The implementation of a compulsory education policy and the expansion of the education system throughout China has made possible for many people there to be well educated. Nonetheless, this expansion did not fully address the pursuit of equality in education. Persistent unequal access to education resources is evident between rural and urban areas, various districts, and class distinctions [43]. Research demonstrated that socioeconomic status continues to be a significant determinant of education equality, enduring through China's reforms and opening up to the world economy, and this influence remains undiminished despite increased enrollment [44].

During compulsory and secondary education, families from privileged socioeconomic backgrounds frequently utilize their resources so children benefit from those institutions with superior facilities. This grants them access to better teaching resources and a favorable learning climate [45]. In contrast, families from underprivileged socioeconomic circumstances lack the social and economic means to offer supplemental support beyond their children's own efforts [43]. These situations result in learning disadvantages for students from disadvantaged SES settings, especially if or when they enter higher education.

Concerning higher education, China now has the largest system in the world [46], witnessing a surge in the gross enrollment ratio from 30% in 2012 to 57.8% by 2021 [47]. The expansion of education extended university access to students from poor or struggling socioeconomic backgrounds [48]. Despite this, the proliferation of higher education has not consistently ensured equitable access to prestigious universities or qualifications that are actually equal [13]. In response, the emergence of RCs in China presents an innovative approach to reforming tertiary education. These RCs embody a novel student affairs mechanism designed to cultivate innovative, creative and well-rounded graduates through a fusion of professional and liberal education. The first RC reforms were implemented in 2005, when some prominent public universities in China piloted this

Fig. 1 Research model diagram
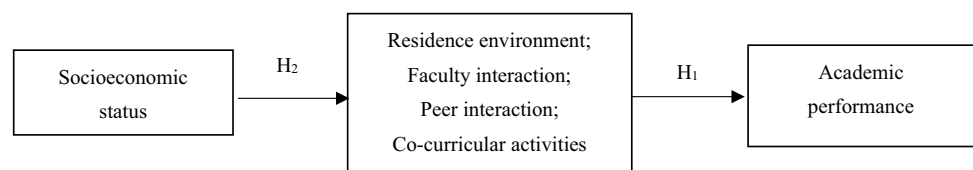
program. China's government introduced a series of related policies regarding RCs from 2012, elevating RC development from an initiative undertaken at the organizational level to part of the national policy level.

This has led to more universities in China piloting this mechanism [49]. Importantly, the increase covers a wider range and variety of universities, including public and private sector institutions, undergraduate and non-undergraduate institutions, and others. The development of RCs in China has undergone a transition from elite education to popular education, with a focus on providing equal access and high-quality learning opportunities for individuals from different social classes. Nonetheless, the extent to which this system indeed facilitates education equality and quality in China warrants further exploration, thus emphasizing the relevance of this paper.

Under these circumstances, more and more higher education institutions have piloted this new paradigm for education [49]. Significantly, this expansion encompasses a broader spectrum of institutions, encompassing both public and private, along with undergraduate and non-undergraduate institutions. The development of RCs in China illustrates the shift from elitism to popularization, heralding a commitment to providing equal and quality education to people from all milieus. Nevertheless, the actual impact of RCs in fostering education equity and quality in the national context requires further exploration, underscoring the relevance of this study.

4 Research design

The rationale for choosing a quantitative method is presented before delving into a discussion of the population, sampling strategy and sample selected for the research. Following this, the chosen data capturing instrument is delineated, followed by an explanation of the selected methods for data collection and analysis.

4.1 Justification for a quantitative method

The research questions primarily examine the relationships between RCs, SES and academic performance. Descriptive statistics are adopted to examine the distribution of students within different SES levels. Moreover, as explained in Sect. 2.3 of this paper two alternative hypotheses were developed for further exploring the correlation between the independent and dependent variables in this study. The hypotheses are tested to comprehend relationships, which can be positive, negative, or causal. Quantitative methods are often employed to analyze these types of relationships [50], and they are suitable for this study.

4.2 Population, sampling and sample

Utilizing the field research, here the focus is on a specific demographic for this investigation, consisting of 67 universities that initiated the adoption of RCs in 2018 or prior to that year. It was considered using the standard duration of undergraduate education in China, typically spanning 4 to 5 years, which guarantees comprehensive academic records for all sampled students. A multi-stage random sampling design was employed to achieve a representative sample. For the purpose of implementing triangulation, participants were selected from universities in different districts. Due to time and financial constraints, a purposive sampling method was used to select one university from each of the western, eastern, and central districts. Within each district, a university was then chosen using simple random sampling, ensuring an equal chance of selection.

The universities from the western, central, and eastern regions provided 112, 448, and 739 students enrolled in RCs, respectively. This led to an overall population size of 1299. The following formula developed by Krejcie and Morgan [51] was used to determine the appropriate sample size:

$$n = \frac{N * X^2 * P * (1 - P)}{\left[e^2 * (n - 1)\right] + \left[X^2 * p * (1 - p)\right]} \tag{1}$$

where n represents the sample size, N denotes the total number of RC students (1299), X^2 stands for the chi-square table value for 1 degree of freedom at a 99% confidence level (6.63), P signifies the population proportion (assumed to be 0.50 to maximize the sample size) and e is the margin of error (0.5). As a result, the total sample size was determined to be 439.

To select the study sample from each university, a proportional stratified sampling method was employed. This resulted in the selection of 38, 151, and 250 RC students from the western, central, and eastern universities,

Table 1 Sources of the scales

Variables	References	Dimensions	Items	Scale
Personal Profile		7	7	Fill-in-blank; Multiple
SES	Chen [54]	3	5 (2 + 2 + 1)	Multiple
RC	Inkelas et al. [38]	4 (7 factors)	28 (3 + 5 + 4 + 4 + 4 + 4 + 4)	5-point Likert

SES socioeconomic status, *RC* residential college. Compiled by authors

Table 2 Reliability test

Factors	Number of items	α
Residential college (RC)	28	0.895
Residence hall environment (RHE)	8	0.792
Academically supportive (RHE1)	3	0.753
Socially supportive (RHE2)	5	0.841
Faculty interaction (FI)	8	0.799
Course-related interaction (FI1)	4	0.817
Faculty mentorship (FI2)	4	0.808
Peer interaction (PI)	8	0.809
Discuss academic/career issues (PI1)	4	0.804
Discuss sociocultural issues (PI2)	4	0.818
Co-curricular activities (CA)	4	0.850
Attend co-curricular activities (CA1)	4	0.850

Compiled by authors

respectively. This technique transforms a divided target population into a more uniform one, thereby ensuring equal chances of selection for each segment and enhancing the sample's representativeness.

4.3 Data collection instrument of the study

The questionnaire used in this study was derived from validated scales employed in a previous study [38, 52]. It includes three parts associated with the study framework. In the initial part, respondents provide personal information, covering aspects such as gender, ethnicity, family district, and academic performance. Academic achievement is assessed based on Cumulative Grade-Point Average (CGPA) with a 4-point scale, following existing literature on education economics [1]. To guarantee data accuracy, this part includes respondents' names and student ID, facilitating the retrieval of accurate CGPA data from academic records at the sampled institutions. The second part refers to SES, encompassing parental monthly income, education attainments, and occupation, across five dimensions. The final part assesses the RCs forming part of the living environment, faculty interaction, peer interaction, and co-curricular activities, across four dimensions. An overview of the scale sources is presented in Table 1.

The instrument's reliability was assessed using the internal consistency coefficient alpha (α). The reliability coefficients for the instrument's different sections after conducting the pilot study are presented in Table 2. An instrument is deemed to be reliable if the alpha values are greater than 0.70 [53]. Subsequently, this questionnaire is judged as valid for the study.

Furthermore, the content of the questionnaire was validated by education experts, RC faculty members and students. Construct validity was tested using Confirmatory Factor Analysis (CFA). The CFA results demonstrated a favorable data fit for the questionnaire ($\chi2/df = 1.063$, GFI = 0.970, RMSEA = 0.009, CFI = 0.997, TLI = 0.997). Convergent validity analysis outcomes are presented in Table 3. All seven factors had Average Variance Extracted (AVE) values that surpassed 0.5, with Composite Reliability (CR) values above 0.7. Each measurement item exhibited a factor loading above 0.6 and displayed statistical significance [54]. Indicated here was robust convergent validity.

Moreover, as shown in Table 4, the square root of AVE between each pair of factors exceeded the expected correlation between them, indicating discriminant validity. Consequently, this questionnaire is deemed to be valid.

Table 3 Convergent validity

Factors	Variables	Std. Estimate	Std. Error	CR	AVE
RHE1: Academic support	Environment supports academic achievement	0.719		0.754	0.505
	It is easy to form study groups	0.731	0.064		
	Adequate study space available	0.682	0.060		
RHE2: Social support	Appreciate different race or ethnicities	0.694		0.841	0.514
	Appreciate different religions	0.740	0.059		
	Help and support one another	0.708	0.059		
	Will recommend this residence hall	0.706	0.059		
	Different students interact with each other	0.735	0.059		
FI1: Course-related interaction	Visit informally with instructor before/after class	0.722		0.817	0.528
	Make appointment to meet instructor in the office	0.711	0.054		
	Consult instructor with information related to course	0.743	0.058		
	Communicate with instructor via e-mail/Wechat	0.730	0.055		
FI2: Faculty mentorship	Discuss personal problems or concerns with instructor	0.718		0.809	0.514
	Work with instructor on independent project	0.695	0.057		
	Attend a cultural event or other activities with instructor	0.743	0.059		
	Discuss career plans and ambitions with instructor	0.709	0.056		
PI1: Discuss academic/career issues	Discuss something learned in class	0.687		0.804	0.507
	Share concerns about classes and assignments	0.711	0.062		
	Talk about current news events	0.734	0.059		
	Talk about future plans and career ambitions	0.715	0.061		
PI2: Discuss sociocultural issues	Discuss social issues such as peace, human rights, justice	0.721		0.818	0.529
	Discuss with students whose personal values are different	0.735	0.059		
	Make appointment to meet instructor in his or her office	0.731	0.059		
	Talk about different lifestyles and customs	0.722	0.056		
CA1: Attend co-curricular activities	Attend career workshops	0.905		0.857	0.603
	Attend community activities	0.721	0.026		
	Attend student clubs and interest groups	0.741	0.026		
	Participate in social or public activities	0.723	0.027		

RHE residential hall environment, *FI* faculty interaction, *PI* peer interaction, *CA* co-curricular activities. compiled by authors

4.4 Data collection

To maintain research objectivity and minimize personal subjectivity, data collection needed to be carried out method-ically. Initially, the data was collected through the online survey from June to August in 2023. In addition, respondents' CGPA data were gathered from the academic office at every sampled university to ensure data accuracy. Permission and support from sampled institutions was secured before commencing the data collection phase. Participation

Table 4 Discriminant validity

Factors	RHE1	RHE2	FI1	FI2	PI1	PI2	CA1
RHE1	**0.711**						
RHE2	0.246**	**0.717**					
FI1	0.261**	0.339**	**0.726**				
FI2	0.231**	0.351**	0.300**	**0.717**			
PI1	0.250**	0.333**	0.333**	0.300**	**0.712**		
PI2	0.273**	0.326**	0.321**	0.302**	0.342**	**0.727**	
CA1	0.193**	0.322**	0.276**	0.345**	0.266**	0.330**	**0.776**

$**p < 0.01$. Compiled by authors

from respondents was voluntary, giving them the choice to quit at any point without facing repercussions or loss of benefits.

A total of 397 valid questionnaire responses were gathered, achieving a strong response rate of 90.4%. The sample consisted of 218 (54.9%) male students and 179 (45.1%) female students, with 353 (88.9%) identifying as Han Chinese and 44 (11.1%) as ethnic minorities. Concerning the family district, 187 (47.1%) respondents hailed from urban areas, while 210 (52.9%) came from rural regions. In terms of enrollment year, 95 (23.9%), 92 (23.2%), 111 (28.0%), and 99 (24.9%) participants were respectively freshmen, sophomores, juniors, and seniors. Evidently, apart from ethnicity, the sample generally exhibited a balanced distribution across college types, gender, family district, and enrollment year.

4.5 Data analysis

The SPSSAU statistics package had been utilized for data analysis, involving both descriptive and inferential analyses. To address the first research question regarding the socioeconomic status of RC students, respondents were compared to the national population ratio based on SES groups by using frequency distributions. For the second research question, investigating the relationship between RC and SES, a multiple regression method with group analysis was employed. Firstly, predictive control variables such as ethnicity, gender, family region, major, and academic year were examined. By incorporating these variables, the impact of academic performance factors in addition to that of residential colleges could be effectively elucidated. Subsequently, grouped linear regression analysis was conducted to statistically assess the relationship between SES and RC. This approach offered an objective evaluation of the effect of RC on educational equity and quality, enhancing the empirical research standpoint. Furthermore this strategy increased the validity of causal assertions by making it easier to distinguish between effects for different groups [55]. The long-term implications of RC on sustainable education were also explored, building on the findings of the first two research questions.

5 Findings and discussions

This section presents the results and discussions concurrently. It is followed by the last section, which explains the research limitations, recommendations for future research, and conclusions.

5.1 Descriptive analysis: SES diversity

To investigate the first research question (RQ1) concerning SES disparities among RC students, the five indicators of SES, including parental education attainment, parental occupation, and income, were initially synthesized into an overall metric using regression analysis, as suggested in the literature [56]. In order to provide a clearer representation of the socioeconomic backgrounds of RC students, SES was categorized into three classifications: high, medium, and low. Among the sample, 31.2% of RC students came from high SES levels, while 29.7% and 39.1% were respectively from medium and low SES levels (see Fig. 2). This confirms that students from various social classes have access to RCs in China.

To further investigate the SES disparity among RC participants and its impact on equitable enrollment, a comparative analysis between the SES composition of these participants and the demographic distribution of the national population across various socioeconomic tiers was conducted. Existing studies have categorized contemporary Chinese social status into ten groups spanning three tiers: high, middle, and low [57]. By utilizing data on individual income and the division of the population among different social ranks, as reported by the NBSC (National Bureau of Statistics of China) [58], it was evident that people from a high social tier constituted the smallest segment, making up about 2.0%. Most of the population fell into the low (47.7%) and middle (50.3%) social tiers (refer to Fig. 3).

Figure 3 illustrates significant differences in the proportions of SES groups between RC students and the overall country population. Notably, the percentage of the country's population with a high SES was the lowest; however, there were 29.2% more RC students of the same socioeconomic status. In contrast, the percentage share of RC participants within the middle SES group was 20.6% lower compared to the country's data, and those within the low SES group were 8.6% lower.

The findings show that RCs in China involve students from diverse SES backgrounds; nonetheless, students from families with a higher SES make up a comparatively larger number. This shows that students from different socioeconomic statuses do not have equal access to higher education possibilities in China. SES is considered one of the most widely used background variables in the field of education research [6, 59]. A number of empirical research studies suggested that SES has a major influence on learning opportunities and outcomes. [7, 8]. The findings corroborate previous research

Fig. 2 Overall percentage of RC students by SES groups. Horizontal axis indicates SES diversity, and vertical axis indicates percentage share of students. Compiled by authors
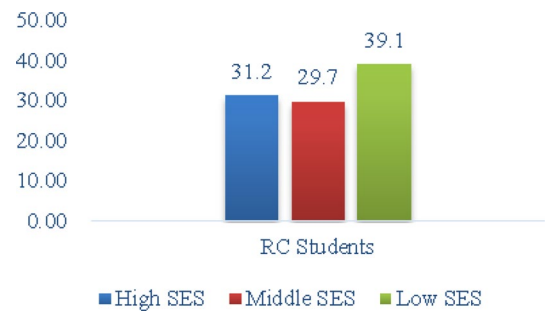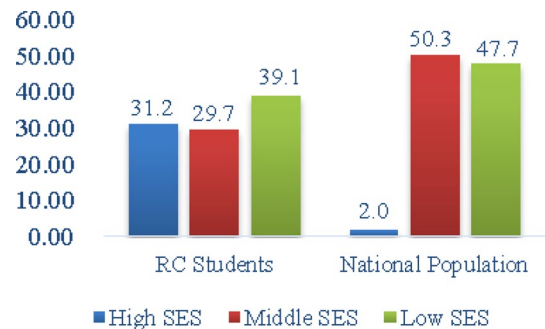

Fig. 3 Comparison of SES groups. Horizontal axis indicates clusters, and vertical axis indicates percentage share. Compiled by authors

indicating that SES can dictate equal access to higher education, even in the context of a presumably 'socialist' China [59]. It also presents empirical proof of the uneven allocation of education opportunities within RCs among students from diverse socioeconomic backgrounds in China.

5.2 Inferential analysis: SES and RCs

To address RQ2, inferential analysis was employed here, utilizing a grouped regression method. It was crucial to investigate the correlation between RCs and academic performance before assessing whether RCs narrow the gap in academic achievement caused by SES. RQ2 comprised two hypotheses and they are referred to here as the first (H1) and second (H2) hypotheses.

H1 proposed that RC has a positive influence on academic achievement. The results of the grouped regression analysis presented in Table 5 indicate a statistically significant positive relationship between RCs and academic performance among participants from various socioeconomic groups ($\beta = 0.684$, $p < 0.01$). Concretely, RCs exhibit a positive impact on the academic performance among students in the low ($\beta = 0.648$, $p < 0.01$), medium ($\beta = 0.443$, $p < 0.01$), and high ($\beta = 0.603$, $p < 0.01$) SES groups. Therefore the evidence supports the claim made by H1.

Following the identification how RCs affect academic performance of students in various SES groups, the regression coefficient difference was examined. This analysis aimed to examine H2, positing that SES disparities do not influence the impact of RCs in enhancing academic achievement. The coefficient differences of group regression are presented in Table 6. No statistically significant differences were observed in the impact of RCs on academic performance between three different SES groups ($p > 0.05$). This suggests that there are no significant differences in the impact of RCs on different SES groups. Consequently, H2 was confirmed by the findings.

Hence, the results confirm a statistically significant association between RCs and academic achievement, demonstrating that RCs have the power to greatly affect student outcomes in university by establishing an extensive and effective climate for learning [17, 18]. Moreover, the outcomes distinctly show that there is no noteworthy difference in the impact of RCs between socioeconomic groups, illustrating that SES does not impede the influence of RC on academic outcomes. Education itself is well recognized as a mechanism to facilitate equity [9, 22]. The results provide empirical evidence that SES does not limit the role of RCs in academic achievement, suggesting that RCs benefit students' learning outcomes regardless of SES origins or barriers. It implies that RCs help narrow the academic performance gap irrespective of SES disparities. Based on this reasoning, RCs represent a positive way to ensure that there is equal access to high-quality education in China.

Table 5 Results of grouped regression analysis

	Overall Group			Low SES Group			Middle SES Group			High SES Group		
	t	p	β	t	p	β	t	p	β	t	p	β
Constant	25.920	0.000	–	16.119	0.000	–	16.513	0.000	–	16.869	0.000	–
Gender	−0 .669	0.504	− 0.022	0.444	0.658	0.027	− 0.239	0.811	− 0.020	− 0.873	0.384	− 0.063
Ethnicity	− 1.622	0.106	− 0.053	− 0.573	0.568	− 0.035	− 0.663	0.509	− 0.056	− 0.445	0.657	− 0.032
District	− 4.140	0.000	− 0.152	− 1.218	0.225	− 0.080	− 1.535	0.128	− 0.130	− 1.006	0.317	− 0.076
Grade	0.063	0.950	0.002	0.075	0.940	0.005	− 0.668	0.505	− 0.056	0.966	0.336	0.070
Major	− 0.458	0.647	− 0.015	− 0.827	0.410	− 0.052	− 0.530	0.597	− 0.045	1.391	0.167	0.098
RC	18.562	0.000	0.684	9.974	0.000	0.648	5.202	0.000	0.443	7.933	0.000	0.603
n		397			155			118			124	
R^2		0.584			0.457			0.237			0.432	
$\triangle R^2$		0.578			0.435			0.195			0.403	
F		91.389			20.754			5.735			14.820	

Dependent variable (DV) is CGPA. *RC* residential college; *n* sample size. Compiled by authors

Table 6 Regression coefficient difference test between SES groups

Name	Item1	Item2	b_1	b_2	Divergence	t	p
Residential college	Low SES	Middle SES	0.363	0.268	0.095	− 1.210	0.277
	Low SES	High SES	0.363	0.280	0.083	− 1.441	0.151
	Middle SES	High SES	0.268	0.280	− 0.011	− 0.195	0.846

DV = CGPA. Compiled by authors

5.3 Extended analysis: RCs and sustainable education

RQ3 was explored through building on the findings on RQ1 and RQ2. It is evident that RCs play a role in promoting academic performance among diverse socioeconomic backgrounds, supporting the objective of mass education in China irrespective of people's SES. Nevertheless, it is essential to acknowledge that the factor of RCs alone cannot fully eradicate enrollment inequality created by the SES gap. Despite the increase in enrollments in higher education, individuals from advantaged socioeconomic backgrounds typically have better access to a superior learning environment that has all the required resources, including RCs. These findings align with the perspective that higher education expansion, leading to high participation systems (HPS), has extended to groups from disadvantaged SES backgrounds [13]. Nevertheless, increasing access to education primarily caters to the needs of advantaged groups and does not necessarily diminish the harsh realities of SES disparities and how these affect access to learning opportunities [13, 48].

The notion of sustainable education extends beyond the pursuit of education quality; it functions as a multifunctional tool. Sustainable education covers a variety of policies, programs, and institutional frameworks designed to contribute to national development in an equitable manner [1]. The problem of inequality in education has a long history [60]. Despite a lot of efforts being made to remedy these inequalities, they remain a key issue in ensuring the progress of sustainable education [1]. In the context of China, RCs offer an innovative strategy to develop talent among students from various socioeconomic settings. While RCs may not completely address enrollment gaps, they do play an important role in advancing the goal of education for all.

6 Limitations and future research

While this paper provides important empirical insights, a few limitations need to be acknowledged in the research on which the findings are based. Addressing these limitations through future research will enhance comprehension of the complex dynamics at work in promoting long-term education equality and equity in the context of RCs.

Discover

Firstly, the research is strictly focused on China, limiting the generalizability of findings to other countries' education systems due to substantial differences in social, cultural, economic and political contexts. To enhance the overall comprehension of the role of RCs in education equity, future research can expand on the worldwide context.

Secondly, academic achievement serves as a crucial benchmark for assessing the quality of education and equity among countries [61]. Multiple factors, both intrinsic (personal characteristics) and extrinsic (teachers, family, and university-related aspects), influence academic achievement [62]. It is important to note that this study does not account for certain potential contributors like personality characteristics, and parental involvement, which could shape study findings. Incorporating a broader range of factors in future research will yield more comprehensive and significant research results.

Thirdly, acknowledging the limitations of the RC system in addressing broader societal and structural factors influencing education outcomes is vital. The RC system alone cannot fully address issues related to local contexts and external influences. Integrating strategies such as financial aid, resources allocation, and policy support with the RC system in different contexts could be necessary for effectively addressing the complex problems of equity in higher education. For future research, the development of RCs should take into consideration more factors, including the dynamics of local contexts. In doing so, creating a localized innovative mechanism is essential for maximizing the potential of RCs to mitigate the impact of SES on access to education and student achievements.

7 Conclusion

The issue of education disparity has been a persistent concern globally. This empirical study employs national data from China to examine whether RCs contribute to reducing education disparities in access and attainment during this era of SDGs. The findings imply that disparities related to families' SES still persist in the RC system. While achieving unbiased and equal access to RCs irrespective of family SES is challenging, the implementation of RCs presents a relatively feasible avenue for minimizing great variations in academic achievement. The significance of RC education in today's world is noteworthy. In essence, the RC system represents a proactive effort to advance sustainable development in education, thereby contributing to national economic progress. Consequently, this empirical study offers valuable insights for decision-makers contemplating the adoption or expansion of RCs within the dynamic landscape of not only China's higher education system but also of other countries.

Data availability This paper used data from the fieldwork conducted as part of a doctoral program and data is not publicly available. However, data can be provided with a personal request.

Declarations

Ethics approval and consent to participate The data collection is approved by the authors' institutional ethical review. Informed consent was obtained from all individual participants included in the study.

Competing interests The authors declare no competing interests.

References

1. Alam GM. Has secondary science education become an elite product in emerging nations?—a perspective of sustainable education in the era of MDGs and SDGs. Sustain. 2023;15(2):1596.
2. Leal Filho W, Kovaleva M, Tsani S, et al. Promoting gender equality across the sustainable development goals. Environ Dev Sustain. 2023;25:14177–98. https://doi.org/10.1007/s10668-022-02656-1.
3. United Nations. Sustainable development. Goals 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Department of Economic and Social Affairs. 2022. https://sdgs.un.org/goals/goal4.
4. Sonetti G, Sarrica M, Norton LS. Conceptualization of sustainability among students, administrative and teaching staff of a university community: an exploratory study in Italy. J Clea Prod. 2021;316: 128292.
5. Tomaszewski W, Perales F, Xiang N, Kubler M. Differences in higher education access, participation and outcomes by socioeconomic background: a life course perspective family dynamics over the life course. Life Course Res Soc Policies. 2022. https://doi.org/10.1007/978-3-031-12224-8_7.
6. Coleman JS. Equality of educational opportunity. Equi Excel Educ. 1968;6(5):19–28.
7. Farooqi SA. The impact of socioeconomic status on college students' experiences. Claremont. 2019. Pitzer Senior Theses. 104. https://scholarship.claremont.edu/pitzer_theses/104.
8. Tompsett J, Knoester C. Family socioeconomic status and college attendance: a consideration of individual-level and school-level pathways. PLoS ONE. 2023;18: e0284188.
9. Alam GM. Do urbanized socioeconomic background or education programs support engineers for further advancement? Int J Educ Ref. 2021;30:344–60.
10. Rahmat N, Buntat Y, Ayub AR. Employability skills based on polytechnic graduate job role: immediate supervisor perception. Asian Soc Sci. 2018;14(11):30–40.
11. Alam GM, Forhad AR, Ismi IA. Can education as an 'international commodity' be the backbone or cane of a nation in the era of fourth industrial revolution? a comparative study. Technol Forecast Soc Chang. 2020;159:120–84.
12. Cunninghame I. The role of higher education in facilitating social mobility. Int Stu Widen Prac. 2017;4(1):74–85.
13. Marginson S. Higher education, economic inequality and social mobility: implications for emerging East Asia. Int J Educ Dev. 2017;63:4–11.
14. O'Hara RJ. How to build a residential college. Plan High Educ. 2001;30:52–7.
15. Baker, MD, Murtazina-Allen A. Residential colleges and their impact on students' sense of belonging. Peabody College of Vanderbilt University. 2021. http://hdl.handle.net/1803/16542.
16. Inkelas KK, Daver ZE, Vogt KE, Leonard JB. Living–learning programs and first-generation college students' academic and social transition to college. Res High Educ. 2007;48:403–34.
17. Hurtado SS, Gonyea RM, Graham PA, Fosnacht K. The relationship between residential learning communities and student engagement. Learn Commu Res Prac. 2020;8:5.
18. Fink JE, Inkelas KK. A history of learning communities within American higher education. New Dire Stu Ser. 2015;149:5–15.
19. Eidum J, Lomicka L, Chiang W, Endick G, Stratton J. Thriving in residential learning communities. Learng Commu Res Prac. 2020;8(1):7.
20. Lawson GM, Farah MJ. Executive function as a mediator between SES and academic achievement throughout childhood. Int J Behav Devel. 2017;41(1):94–104.
21. Gui PP, Alam GM, Hassan AB. Does the concept of residential college offset the effects of socioeconomic status on university students' academic performance? J Appli Res High Educ. 2023. https://doi.org/10.1108/JARHE-07-2023-0270.
22. Erdem C, Kaya M. Socioeconomic status and wellbeing as predictors of students' academic achievement: evidence from a developing country. J Psyc Couns Sch. 2023;33:202–20.
23. Davis LD. Common core and the continued socioeconomic achievement gap: how can we better prepare future teachers? J Educ Learn. 2019;8(6):1–14.
24. Poon K. The impact of socioeconomic status on parental factors in promoting academic achievement in Chinese children. Int J Educ Dev. 2020;75:2–9.
25. Jiang M, Jong M, Lau WWF, Luk ET. Does ICT use matter between socioeconomic status and academic performance? 2019 International Symposium on Educational Technology (ISET), Hradec Kralove; 2019. https://doi.org/10.1109/ISET.2019.00026.
26. Alam GM, Forhad MAR. What makes a difference for further advancement of engineers: socioeconomic background or education programs? High Educ. 2022;83(6):1259–78.
27. Downey DB, Condorn DJ. Fifty years since the Coleman Report: rethinking the relationship between schools and inequality. Socio Educ. 2016;89(3):207–20.
28. Ware JK. Property value as a proxy of socioeconomic status in education. Educ Urb Soc. 2019;51(1):99–119.
29. Kincaid AP, Sullivan AL. Parsing the relations of race and socioeconomic status in special education disproportionality. Reme Spec Educ. 2017;38(3):159–70.
30. Conger RD, Donnellan MB. An interactionist perspective on the socioeconomic context of human development. Annu Rev Psycho. 2007;58:175–99.
31. Dahl LS, Duran A, Hooten ZJ, Stipeck CJ, Youngerman E, Mayhew MJ. Investigating the influence of residential learning communities on student experiences. Learn Commu Res Prac. 2020;8:6.
32. Choi KY. Residential colleges as living-learning communities in China: Some recent developments. In: Wu B, Morgan WJ, editors. Chinese higher education reform and social justice. London: Routledge; 2016. p. 94–110.
33. Mayhew M, Dahl L, Youngerman E, Duran A. Study of integrated living learning programs SILLP full report. 2016. https://www.researchgate.net/publication/330202802_Study_of_Integrated_Living_Learning_Programs_SILLP_Full_Report.
34. Stassen MLA. Student outcomes: the impact of varying living-learning community models. Res High Educ. 2003;44(5):581–613.
35. Stier MM. The relationship between living learning communities and student success on first-year and second-year students at the University of South Florida. 2014. https://scholarcommons.usf.edu/etd/5133.

36. Friswold-Atwood S. Living-learning communities effect on students' self-efficacy of their successful social and academic transition to college. 2018. UNF Graduate Theses and Dissertations. 845. https://digitalcommons.unf.edu/cgi/viewcontent.cgi?article=1900&context=etd.

37. Pike G, Schroeder CC, Berry TR. Enhancing the educational impact of residence halls: the relationship between residential learning communities and first-year college experiences and persistence. J Col Stu Dev. 1997;38(6):609–21.

38. Inkelas KK, Vogt KE, Longerbeam SD, Owen J, Johnson D. Measuring outcomes of living-learning programs: examining college environments and student learning and development. J Gen Educ. 2006;55:40–76.

39. Buell KJ, Love VL, Yao CW. Living-learning programs through the years: a reflection on partnerships between students, faculty and student affairs. Fac Pub Educ Admin. 2017;82:86–101.

40. Backer DI, Cairns K. Social reproduction theory revisited. British J Socio Educ. 2021;42(7):1086–104.

41. Bourdieu P, Passeron JC. The inheritors: French students and their relation to culture. Chicago: University of Chicago Press; 1979.

42. Collins J. Social reproduction in classrooms and schools. Annu Rev Anthro. 2009;38:33–48.

43. Borer M, Bai Y, Fonseca F. A review of the literature on socioeconomic status and educational achievement. Socio Inequa Educ Out. 2019;5:7–17.

44. Wu XG. Higher education, elite formation and social stratification in contemporary China: preliminary findings from the beijing college students panel survey. Chinese J Socio. 2017;3(1):3–31.

45. Liu R, Sun GY. Reflections on achieving educational equity in China from the perspective of social stratification. Educ Res. 2019;2(5):15–9.

46. Ministry of Education of the People's Republic of China. Effectiveness of higher education reform and development in China. 2022. http://fx.xwapp.moe.gov.cn/article/202205/6282ee468323640001a37f6d.html.

47. Ministry of Education of the People's Republic of China. Statistical Report on China's Educational Achievements in 2021. 2022. http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/202209/t20220914_660850.html.

48. Marginson S. The worldwide trend to high participation higher education: dynamics of social stratification in inclusive systems. High Educ. 2016;72:413–34.

49. Gong H, Su YB, Zhou Y. Residential college development report 2020. Xi'An: Xi'An Jiao Tong University Press. 2021.

50. Azevedo A, Apfelthaler G, Hurst D. Competency development in business graduates: an industry-driven approach for examining the alignment of undergraduate business education with industry requirements. Int J Manag Educ. 2012;10(1):12–28.

51. Krejcie RV, Morgan DW. Determining sample size for research activities. Educ Psycho Measure. 1970;30:607–10.

52. Chen J. Study on the influence of family socio-economic status on college students' employment expectations. Guizhou: Guizhou Normal University; 2022.

53. Schuurman NK, Hamaker EL. Measurement error and person-specific reliability in multilevel autoregressive modeling. Psycho Metho. 2019;24(1):70–91.

54. Shi HY, Jing FJ, Yang Y, Nguyen B. The concept of consumer vulnerability: scale development and validation. Int J Consu Stu. 2017;41:769–77.

55. Genser B, Teles CA, Barreto PPG, Fischer JE. Within- and between-group regression for improving the robustness of causal claims in cross-sectional analysis. Environ Heal. 2015;14:60.

56. Green LW. Manual for scoring socioeconomic status for research on health behavior. Pub Heal Rep. 1970;85(9):815–27.

57. Zhang WH. Social stratification and class harmony in contemporary China. Beijing: Social Sciences Academic Press; 2021.

58. National Bureau of Statistics of China. China statistical yearbook—2022. 2023. http://www.stats.gov.cn/sj/ndsj/2022/indexch.htm.

59. Nikula P-T. Socioeconomic inequalities in higher education: a meta-method analysis of twenty-first century studies in Finland and New Zealand. Stu High Educ. 2017;43(12):2305–20.

60. Cullinan J, Flannery D, Harold J, Lyons S, Palcic D. The disconnected: COVID-19 and disparities in access to quality broadband for higher education students. Int J Educ Tech High Educ. 2021;18:1–21.

61. Salder DR. Academic achievement standards and quality assurance. Qua High Educ. 2017;23(2):81–99.

62. Macakova V, Wood C. The relationship between academic achievement, self-efficacy, implicit theories and basic psychological needs satisfaction among university students. Stu High Educ. 2020;47(2):259–69.