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<https://doi.org/10.1057/s41599-025-06264-y>

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Reproducing Inequality? Social Capital, Digital Literacy, and SES in Access to Higher Education

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Access to higher education and high-quality sources has become a new focus in the digital transformation framework now that higher education is expanding. With a focus on the roles of digital literacy and socioeconomic status (SES), this study examines the influence of social capital on China's high school graduates' access to higher education. Regression and group regression analyses are used in this study to examine the mechanism shaping learning opportunities based on survey data from 629 students in China's western, central, and eastern provinces. The results indicate that while social capital positively correlates with access to higher education across all groups, its advantages are more pronounced among high SES students, especially regarding entrance to elite universities. Furthermore, social capital is partially mediated by digital literacy. These findings highlight the importance of employing intervention measures to help students from underprivileged backgrounds and the varied methods shaping students' learning prospects in China.

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Introduction

In the era of economic development known as Industry 4.0, digital technology is reshaping the pathways through which resources and opportunities are accessed, and higher education is no exception (Wang et al., 2024). Open resources and academic support services provided through digital platforms facilitate academic preparation for those pursuing higher education (Adil et al., 2024). As well, open access to higher education admission information provides applicants with channels to obtain information that aids them in making decisions about their education (Mohamed Hashim et al., 2022). However, the ability to utilize digital technologies to access these open resources and information depends on an individual's digital literacy. This refers to processes such as searching for university information, interpreting admission policies, academic preparation, and using digital platforms (Timotheou et al., 2023). In this context, digital literacy is no longer merely a basic skill and it has in fact become a new factor influencing an individual's access to higher education.

However, digital literacy is not an innate ability but instead a social skill cultivated through exposure to technological environments, targeted guidance, and access to digital tools (Meng et al., 2025). Thus, digital literacy depends not only on individual aptitude but also on the availability of resources and the quality of support systems within an individual's environment (Timotheou et al., 2023). Existing research indicates that socioeconomic status (SES) plays a critical role in shaping an individual's digital literacy (Cao et al., 2024). Students from privileged SES backgrounds are more likely to: firstly, have access to digital devices and the internet at home; secondly, receive support and guidance from family members with higher digital literacy; and thirdly, attend schools with better technological infrastructure. In contrast, students from poorer SES backgrounds often experience limitations in terms of digital exposure and support, leading to uneven development or little progress at all when it comes to cultivating digital skills (Lou et al., 2024).

It has been argued by Pitzalis and Porcu (2024) that digital literacy possesses the characteristics of cultural capital, manifesting as something that is very important for educational success. Bourdieu's (1986) theory of capital and its mechanisms of capital conversion emphasize the possibility of transforming social capital into cultural capital. Within this theoretical framework, the social capital individuals possess can be converted into digital literacy—a new form of cultural capital—through information dissemination, role modelling, and guidance within social networks (Calderon Gomez, 2021). This conversion not only translates into academic advantages but also becomes a key variable in the educational reproduction mechanism of the digital age (Feng and Tan, 2024).

Digital literacy has become a foundational skill in the navigation of higher education in the digital age, influencing how students access, interpret, and respond to academic information and institutional requirements (Reddy et al., 2022; Buchan et al., 2024). Given digital literacy depends on both material access and social support, it not only reflects individual capabilities but is also rooted in SES and social capital that shape individuals (Tondeur et al., 2011; Calderon Gomez, 2021). SES and social capital together constitute the pathways to accessing digital resources and learning environments, thereby shaping students' digital capabilities in highly competitive education environments (Kai, 2022). In this context, digital literacy serves as a critical mediating resource, linking family background to access to higher education.

Research scope and gap

The impact of SES on access to higher education has been extensively studied, and scholars have also emphasized the

importance of social capital (such as social networks and parental involvement) in shaping educational opportunities (Kosunen et al., 2021; Apfeld et al., 2022; Mello, 2022). However, insufficient attention has been paid to the joint mechanisms through which SES, social capital, and digital literacy collectively influence higher education opportunities in the digital age. Especially in the context of digital literacy as a new form of cultural capital in the digital age (Tondeur et al., 2011), questions such as whether it aligns with Bourdieu's theory on the transformation of social capital into cultural capital, and whether it plays a reproductive role in the process of accessing educational opportunities, have not been sufficiently explored in empirical research. This study draws on Bourdieu's (1986) capital theory framework, positing digital literacy as an emerging form of cultural capital. It also seeks to explore how SES and social capital influence individuals' likelihood of accessing higher education admission opportunities through the accumulation and distribution of digital literacy.

Research aim and questions

This study is grounded in the theoretical framework of capital conversion mechanisms and reproduction theory within a digital context, aiming to explore how SES and social capital shape an individual's digital literacy, which in turn affects their access to higher education. To achieve this goal, this study seeks to make the following contributions. First, this study extends cultural capital theory by defining digital literacy as a new form of cultural capital and exploring its operational mechanisms in technology-driven educational environments. Second, this study highlights how digital literacy interacts with social capital to shape educational opportunities in ways that differ from traditional cultural resources. Third, by exploring heterogeneity across socioeconomic subgroups, this study provides nuanced insights into emerging patterns of digital inequality, deepening our understanding of digital inequality. Fourth and finally, given the new challenges facing equal educational opportunities in the digital age, this research has important practical implications for policymakers and educational institutions committed to promoting equity in higher education. The following questions were developed in accordance with the research aims:

- (1) What are the disparities of access to higher education, social capital and digital literacy among various SES student groups?
- (2) How do SES and social capital influence an individual's level of digital literacy?
- (3) Does digital literacy play a mediating role between social capital and access to higher education?
- (4) Does digital literacy play a mediating role between social capital and access to different types of higher education?

After clarifying the purpose of this research, the theoretical foundation will provide a framework and explore the relationships between variables and their relevance to the research path. Following the discussion of the research design, the research results, discussion, and conclusions will be presented in that sequence.

Theoretical foundation

Bourdieu's Capital and Social Reproduction Theories as the Theoretical Framework. Bourdieu's (1986) capital theory provides a framework to help us understand how educational inequality is rooted in social reproduction. Bourdieu conceptualizes capital in multiple forms - economic, cultural, social and symbolic—each of which can be mobilized and transformed under specific conditions (Bourdieu, 1986; Schirone, 2023). These

forms of capital are unevenly distributed among social groups (Alecú et al., 2022). The transformation of one capital into another will give some groups cumulative advantages, while other groups are subject to structural constraints. This unequal accumulation and transformation implicitly shape individuals' learning trajectories (Yu et al., 2022). Importantly, the field of education is a critical site for the exchange, accumulation and institutionalization of various types of capital, which reinforces existing social hierarchies by recognizing and legitimizing the cultural and social resources that the dominant group already possesses (Bourdieu and Passeron, 1977; Hwami and Bedeker, 2024).

Social capital refers to the total resources individuals acquire through stable interpersonal networks or institutionalized relationships (Portes, 2024). In the field of education, social capital manifests as family-school collaboration, information channels between parents and educational resources, and the academic or developmental social networks children are exposed to (Keung and Cheung, 2023; Jortveit and Daush, 2025). Cultural capital refers to the cultural abilities and refinement individuals acquire through family socialization and the education process (Xie and Hutagalung, 2025). Given that cultural capital has the potential to translate into social status and financial rewards in education and the labor market, it has become a key variable in education and social reproduction (Morales, 2025). Social capital can be used to access high-quality educational information and resources through social networks, and the advantages of these resources influence students' embodied states and objectified states. These are then converted into the accumulation of cultural capital through institutionalized means, ultimately manifesting in differences in individual educational performance and opportunity acquisition (Hu, 2023).

Bourdieu emphasizes that these capital-based advantages are not limited to individual efforts or chance, but are passed down from generation to generation (Xiao and Liu, 2023). Through early upbringing, educational tracking, and institutional control, children from privileged families inherit not only material resources, but also personalities, expectations, and social norms that are consistent with institutional norms (Jackson, 2022). Drawing on Bourdieu's theory, this study explores how social factors transform into individual educational opportunities through capital distribution.

Digital Literacy as a Form of Cultural Capital. Cultural capital is understood as a non-economic form of social advantage that contributes to social stratification, especially in the context of education (Xie and Hutagalung, 2025). It exists in three states: embodied, objectified and institutionalized. Embodied cultural capital refers to deep-seated tendencies, abilities and ways of thinking that have been internalized through long-term socialization. Objectified cultural capital encompasses cultural products such as books, musical instruments and technology, while institutionalized cultural capital refers to formally recognized certificates and qualifications (Bourdieu, 1986). Each type of cultural capital has its own unique characteristics. It is persistent, unevenly distributed, and closely linked to class experience. Cultural capital is transformed into academic achievement, social recognition, and upward mobility through the institutionalized recognition process of the educational field (Aksakal and Schmidt, 2021; Hu and Wu, 2021). In this way, cultural capital becomes a subtle and powerful mechanism of social reproduction.

Digital literacy refers to the ability to access, evaluate, use, and create digital content through digital technologies (Tinmaz et al., 2022; Wan et al. 2021). It gains institutional recognition through formal incorporation into curriculum standards and certification

qualifications. Individuals with digital literacy have an advantage in the digital environment, making it easier for them to obtain symbolic and material social rewards (Apps et al., 2023). This function of obtaining symbolic and material social rewards in the institutional sphere aligns with Bourdieu's argument regarding the function of cultural capital. Furthermore, cultural capital is acquired and accumulated through the process of socialization (Roaldsnes, 2024). Similarly, the acquisition of digital literacy is not based solely on technology but is in fact internalized through exposure to a technology-rich environment and shaped by the interaction of support systems in social networks (Meng et al., 2025). In the same way that the accumulation of traditional cultural capital is unevenly distributed as a result of intergenerational transmission, digital literacy also reflects disparities between different social groups.

Thus, as digital literacy shares the same functions and characteristics as cultural capital, it is regarded as the emerging cultural capital of the digital age (Pitzalis and Porcu, 2024). According to Bourdieu's theory of capital convertibility, social capital can be converted into cultural capital under certain conditions, and digital literacy is also applicable to this conversion process (Calderon Gomez, 2021). Individuals acquire digital literacy through social capital, forming cultural capital that is recognized by institutions. This provides them with an advantage in accessing education, and in this way revealing the conversion and reproduction of social capital and cultural capital in education.

The Role of SES and Social Capital in Digital Literacy. Digital literacy, as a skill closely linked to learning, communication, and information access, has been extensively studied and proven to be influenced by SES and social capital (Calderon Gomez, 2021; Cao et al., 2024; Lou et al., 2024). SES is measured by parental education level or qualifications, parental occupation, and income, and plays a critical role in individuals' access to digital resources and mastery of digital skills (Gui and Alam, 2024). Students from high SES backgrounds are exposed earlier to digital technology at an early age, benefit from stable internet access, and possess supportive learning environments (Tondeur et al., 2011). These material conditions and supportive settings foster the development of their digital literacy.

Furthermore, through the support of social capital, students are able to convert their economic and social resources into digital literacy, a form of cultural capital increasingly vital in the digital era (Calderon Gomez, 2021). Social capital refers to resources embedded in social networks and interpersonal relationships, which promote digital skills development through informal support, knowledge sharing, and role modelling (Calderon Gomez, 2021). The use of digital tools and platforms is aided by parental involvement, peer influence, and institutional relationships, leading to digital literacy development (Timotheou et al., 2023). Moreover, social capital and SES are related and influence digital literacy. Higher SES assists in accumulating stronger forms of social capital, amplifying digital advantages (Tuominen and Tikkanen, 2023). In contrast, access to technology is constrained by lower SES and poor social networks, which also impede the development of powerful digital practices. Grounded in the theoretical insights discussed above, the study advances the following hypothesis:

H1: Social capital has a positive effect on digital literacy across diverse SES groups.

Pathways from SES and Social Capital to Educational Access through Digital Literacy. SES, cultural capital, and social capital interact to drive the process of educational reproduction

(Bourdieu, 1986). Higher SES families have more economic and cultural resources, providing their children with extensive educational support and high-quality growth conditions (Rogosić and Baranović, 2016). This promotes the accumulation and transmission of cultural capital, thereby influencing their educational opportunities and academic achievement (Yang and Sun, 2023). Similarly, social capital provides individuals with resources, information, and support through interpersonal networks, thereby boosting their cultural capital and reinforcing their advantages in accessing educational opportunities (Guan and James, 2020; Hu, 2023).

As a new type of cultural capital, digital literacy (Timotheou et al., 2023) serves as a link between resources and educational access. Digital literacy encompasses basic information technology skills and advanced abilities such as critical thinking, information literacy, and digital communication (Tinmaz et al., 2022). Higher levels of digital literacy enable individuals to make better use of resources and participate in digital learning environments, increasing their competitiveness (Timotheou et al., 2023). Research has discovered that, as a new form of cultural capital, digital literacy relies on the economic and cultural resources provided by SES (Lou et al., 2024), as well as the supportive social environment and resource channels constructed by social capital (Calderon Gomez, 2021). These aid individuals in converting social and economic resources into electric cultural capital, meaning they have a greater opportunity of enrolling in higher education.

Consequently, digital literacy which serves as a link between SES, cultural capital, and social capital, has become an indispensable component of educational reproduction. The social structural mechanism that underlies the digital divide can be understood theoretically from this standpoint. With reference to prior empirical and theoretical work, the following hypotheses are formulated:

H2: Digital literacy mediates the relationship between social capital and access to higher education

H3: Digital literacy mediates the relationship between social capital and access to different types of higher education

Research context

Previous research has explored the role of SES, social capital, and digital literacy in shaping educational access. However, the mechanisms underlying these influences are tied to the institutional context. Given China's unique examination-oriented education system and hierarchical university structure, it is necessary to outline the specific features of China's institutional context.

In China, the transition from high school to higher education relies primarily on the highly competitive national college entrance examination (Gaokao), held after grade 12. Students then submit university and program applications, and are matched for admission based on their Gaokao scores. However, the expansion of higher education has reduced the competitiveness of Gaokao and expanded access, but it has also exacerbated academic inflation and the devaluation of qualifications. While the competitiveness of a Bachelor's degree in the labor market has declined, the signaling of a degree from an elite university has become increasingly prominent. A degree from an elite university symbolizes scarce educational resources and academic achievement, becoming an important indicator of individual ability and potential and a key to career advancement in a society where academic credentials are paramount.

Furthermore, the transition from secondary to higher education is associated with regional disparities in educational resources and digital infrastructure. Students in resource-rich regions have greater access to high-quality teacher support and

technology-based learning tools, while those in resource-poor regions face limitations. To capture these regional imbalances, this study draws on data from three provinces in eastern, central, and western China, which vary in economic and educational development. It aims to explore how institutional context interacts with SES, social capital, and digital literacy to influence higher education access.

Methodology

Cross-sectional surveys are a suitable method for examining whether SES and social capital are associated with access to higher education, and the extent to which these associations are mediated by digital literacy. Bryman (2016) points out that this method can capture overall trends and group differences within the population, consequently revealing the relationships between variables. In addition, high school graduates were targeted as participants for their role as the reserve force for higher education. Their experiences can provide important insights into the relationship between SES, social capital, digital literacy, and access to higher education in the digital environment.

Participants and sampling

There are more than 15,400 high schools in China, namely provincial model high schools (PMHS), urban general high schools (UGHS), and rural general high schools (RGHS). Different types of high schools have different types and amounts of resources and digital facilities, and also offer different opportunities to students in their attempts to enroll in higher education. Millions of students graduate from these schools, forming a diverse group in terms of socioeconomic, regional, and educational conditions. Given the large size of this group and its significant internal differences, this study adopted a three-stage stratified sampling strategy to enhance the representativeness of the sample and ensure diversity in regions and school types.

First, the sampling frame was divided into three geographic strata, representing eastern, central, and western China, regions that differ in the availability of educational resources and technological infrastructure. Within each stratum, a province was randomly selected from a list of all provinces in the region. Second, within each selected province, all high schools were divided into three categories: model high school, general urban high school, and rural high school. One school from each category was randomly selected. This process ultimately resulted in the selection of 9 schools, reflecting regional and institutional diversity. Third, after selecting 9 schools, a proportional stratified random sampling was conducted within each school to ensure triangulation (Cohen et al., 2011). The sampling frame consisted of lists of graduate students. To ensure confidentiality, these lists contained only student numbers and did not contain names or other personally identifiable information. The total number of graduates from these 9 high schools in 2024 is 12,579. Subsequently, Krejcie and Morgan's (1970) sample calculation formula was used to determine the sample size, where n represents the required sample size, N represents the target population size (i.e., the total number of graduates), X represents the critical value (99%) confidence level (6.63), P represents the sample proportion (0.5), and e stands for the allowable sampling error (set to 5% or 0.05 in this study).

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

A total of 629 graduates were included in the sample. The proportional method was used to calculate the number of students required to sample each school. With the assistance of the academic affairs offices at the sampled schools, participants were

randomly selected using lists of students. The first thing to do was to list the number of all students in each school on an Excel spreadsheet. Then the =RAND() function served to generate a random number between 0 and 1 for each student. Then, the list in ascending order based on the generated random numbers was sorted and the required number of students for that school from the top of the list was selected. This process ensures that every student in each school has an equal chance of being selected. Information concerning the demographic features of the sample population is summarized in Table 1 below.

Measures

In this study, primary and secondary data were employed. The former were collected through structured questionnaires to measure one of the independent variables (social capital) and mediation variable (digital literacy). Secondary data collected from institutions were utilized to measure the other independent variable (SES) and dependent variables (access to higher education).

Social capital was operationalized based on the framework proposed by Putnam (2000) and Coleman (1988), where social networks, trust, and reciprocity are considered core components. Accordingly, the questionnaire used to measure social capital was adapted from the instrument developed by Tuominen and Haanpää (2022) for assessing adolescent social capital. The original questionnaire contains three aspects: social networks (SN, 4 items), reciprocity (RE, 4 items) and social trust (ST, 7 items). The social

trust (7 items) concept was designed to measure trust in family, friends, neighbors, classmates, school personnel, random domestic passers-by, and random foreign passers-by. Considering the scope of this study, social capital focuses on the family, school and community, and for this reason the social trust section contains only the first five items and removed the last two items. Finally, the adapted questionnaire consists of 13 items. The sample item is “If I have a problem, my family member will help me.” Responses were rated on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). The Cronbach’s alpha coefficient of the questionnaire was 0.81, indicating the reliability was acceptable.

Digital literacy was operationalized according to the DigComp framework (Vuorikari et al., 2016), which identifies information processing, communication, safety, ethics, and self-regulation as its fundamental components. The questionnaire devised to measure digital literacy was adopted from the local scale devised by Wan et al. (2024) and includes 28 items across seven dimensions: information-seeking abilities (IS1, 4 items), information evaluation abilities (IE, 4 items), information storage abilities (IS2, 4 items), digital communication and cooperation abilities (CC, 4 items), self-regulation abilities (SR, 3 items), digital safety awareness (DS, 5 items), and digital ethics (DE, 4 items). The sample item is “When I encounter a problem, I know how to search for the information I need online.” Responses were rated on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). The Cronbach’s alpha coefficient of the questionnaire was 0.85, indicating the reliability was acceptable.

Construct validity can be assessed through convergent validity and discriminant validity. According to Hair et al. (2010), a CR greater than 0.7 indicates good internal reliability; an AVE greater than 0.5 strongly suggests that the variable explains more than 50% of the variance in its measured items, demonstrating good convergent validity. The data from this study showed that the CR and AVE of all factors met these criteria (as shown in Table 2), indicating that the questionnaire possesses convergent validity. Since the AVE of each construct item was higher than the squared correlation coefficient between the corresponding construct items, the model exhibits discriminant validity.

SES was operationalized using parents’ level of education or qualification, occupation, and household monthly income, each of which was further divided into several ordered categories (Sun & Zhou, 2023; Gui et al., 2024). Parental education or qualification was measured using a five-level scale: (1) primary school and below, (2) junior high school, (3) high school/vocational high school, (4) college/Bachelor’s degree, and (5) Master’s degree and above. Parental occupation was divided into five categories: (1) unemployed or not in the labor force, (2) manual laborer, (3) office worker or small business owner, (4) skilled worker or middle-level manager, and (5) professional or senior manager. Household monthly income was divided into twelve levels, ranging from (1) less than 2,000 yuan to (12) 12,000 yuan and above. The SES index

Table 1 Demographic information of sample.		
Variables	All graduates	Graduates admitted to HE
Gender		
Male	295	199
Female	334	237
Household Registration		
Urban	374	273
Rural	255	163
Region		
Eastern	219	174
Central	202	129
Western	208	133
School Category		
PMHS	307	247
UGHS	241	149
RGHS	81	40
Total	629	436

Note: PMHS refers to provincial model schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Table 2 CFA analysis.												
Factors	CR	AVE	SN	RE	ST	IS1	IE	IS2	CC	SR	DS	DE
SN	0.865	0.612	0.785									
RE	0.872	0.628	0.078	0.790								
ST	0.863	0.568	0.089	0.185	0.749							
IS1	0.871	0.628	0.122	0.188	0.116	0.793						
IE	0.876	0.638	0.079	0.132	0.150	0.090	0.799					
IS2	0.876	0.639	0.087	0.147	0.135	0.145	0.106	0.799				
CC	0.861	0.608	0.128	0.067	0.141	0.141	0.063	0.053	0.780			
SR	0.869	0.689	0.069	0.155	0.020	0.083	0.082	0.068	0.045	0.830		
DS	0.876	0.586	0.136	0.130	0.118	0.139	0.120	0.172	0.023	0.125	0.766	
DE	0.868	0.623	0.142	0.085	0.107	0.066	0.075	0.066	0.034	0.011	0.102	0.789

was calculated by combining these three standardized indicators. The three components were first converted into standardized scores. A weighted composite SES score was then calculated using the following formula ($SES = (0.82 * \text{parental education level} + 0.81 * \text{parental occupation} + 0.76 * \text{income}) / 0.63$). Participants were then divided into three SES groups (low, medium, and high) based on tertile cut-offs of the composite score.

Access to higher education was measured using two dependent variables: a binary variable indicating whether graduates accessed higher education (1=access to any higher education institution, 0 = no access); and a categorical variable classifying the type of institution attended—research universities (representing elite institutions), applied universities (focused on practical and professional training), and vocational colleges (providing technical and skills-based education) which code as 3, 2, 1. Both SES and access to higher education are collected from the academic affairs office of the target schools. Meanwhile, demographic characteristics, namely gender (female = 1, male = 0), household registration (rural = 1, urban = 0), region (western = 1, central = 2, eastern = 3), and school type (RGHS = 1, UGHS = 2, PMHS = 3) were included as control variables. In addition, given the potential impact of shadow education participation on access to higher education (Kosunen et al., 2021), this was also controlled as a binary variable (yes = 1, no = 0).

Data collection and procedures

Data collection was conducted from November 15, 2024, to January 15, 2025. The first author contacted the target schools to explain the purpose of the study and the information required from the institutions. Prior to fieldwork, ethical approval was obtained from the ethics committees of two universities (Approval Nos.: JKEUPM-2024-439 and SCWLL20240905, respectively). Subsequently, permission was also granted by each participating school to conduct the survey and link administrative records with student responses. All respondents provided informed consent before participating in the survey. Participants were informed about the purpose and procedures of the study, as well as their right to withdraw at any time without any consequences. Survey data were collected from students who had completed secondary education. All respondents participated in the survey after graduating from high school to ensure they had successfully transitioned to higher education. The survey was conducted approximately six months after students graduated to gather accurate information about their higher education access.

Graduates were randomly selected based on student numbers and were contacted by school staff to complete the questionnaires online. After filtering for valid responses, student numbers were used to retrieve secondary data on SES, access to higher education, and control variables. Student numbers were used only to match administrative records with survey data and were immediately deleted after linkage. The dataset used for analysis was fully anonymized to ensure confidentiality and adherence to ethical standards. All secondary data were obtained from official institutional records to ensure accuracy.

Data analysis

A series of analyses were conducted in a sequential manner to address research questions and satisfy the prerequisites for mediation analysis. To address RQ1, descriptive statistics were first performed on key variables and compared by students' SES groups. Subsequently, to meet the prerequisites for mediation analysis, logistic regression models were estimated for each dependent variable to address RQ3 and RQ4. Given that the first outcome variable, access to higher education, is dichotomous, binary logistic regression was used as it meets the assumptions of

binary outcome modeling. For the second outcome variable, type of higher education institution, which is a categorical variable with multiple categories, multinomial logistic regression was used as it appropriately accounts for the disordered nature of the outcome. Next, multiple linear regression and subgroup analyses were conducted to address RQ2. These analyses assessed the association between social capital and digital literacy and compared differences across SES groups. These analyses also met the requirements for subsequent mediation tests. All models controlled for gender, household registration, shadow education, region, and school type, and examined the relationship between the independent variables and the outcomes.

Mediation analyses were then conducted using the Karlson-Holm-Breen (KHB) method to explore the mediating role of digital literacy in the relationship between social capital and access to higher education and access to different types of higher education. The KHB method relies on the strong serial ignorability assumption, which requires that, given the presence of the independent variable, there are no unmeasured confounders that could affect the relationship between the independent variable and the mediating variable, or between the mediating variable and the dependent variable. Gender, household registration, shadow education, region, and school type were included as covariates precede social capital and digital literacy to reduce the possibility of omitted variable bias. The KHB technique is able to robustly estimate mediation effects and is suitable for mediation analysis involving nonlinear outcome variables (e.g., binary or categorical dependent variables). It can decompose the overall effect into direct and indirect paths and allows for unbiased comparison of coefficients across nested models by adjusting for rescaling issues (Karlson et al., 2012).

Results

Descriptive analysis. As shown in Fig. 1, the higher education paths of different SES groups reveal a clear stratification. The proportion of students who do not have access to higher education increases significantly the lower their SES circumstances are (high SES students: 18.13%; low SES students: 50.26%). Similarly, compared with high SES students, low SES students are more likely to attend vocational colleges (CV: 44.19%) and less likely to enter research universities (RU: 11.63%). Notably, the proportion of students from high SES backgrounds who can access research universities (58.14%) is more than five times that of their low SES peers (11.63%).

As shown in Fig. 2, the results of the one-way ANOVA revealed significant differences in social capital among different SES groups, $F(2, 626) = 3.869, p = 0.021$. Similarly, the results of the one-way ANOVA depicted in Fig. 3 show that there were significant differences in digital literacy across SES groups, $F(2, 626) = 16.894, p < 0.001$.

Influence of social capital on access to higher education across SES groups

The association between social capital and access to higher education was first examined. Results summarized in Table 3 indicated that social capital is significantly positively correlated with access to higher education, and this result is valid for the full sample and SES subgroups. The odds ratio (OR) of the full sample is 2.104, that is, for every unit increase in social capital, the probability of a student obtaining a higher education opportunity increases by 2.104 times. The results of group regression show that for every unit increase in social capital of the high SES students, the probability of obtaining a higher education opportunity increases by 2.788 times; for every unit increase in social capital of the medium SES group, the probability of obtaining a higher education opportunity increases by 2.042

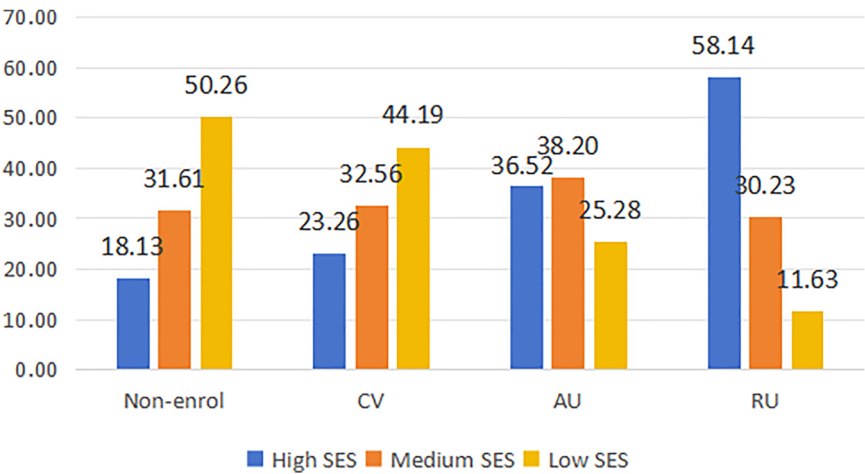


Fig. 1 Distribution of Higher Education Pathways by SES.

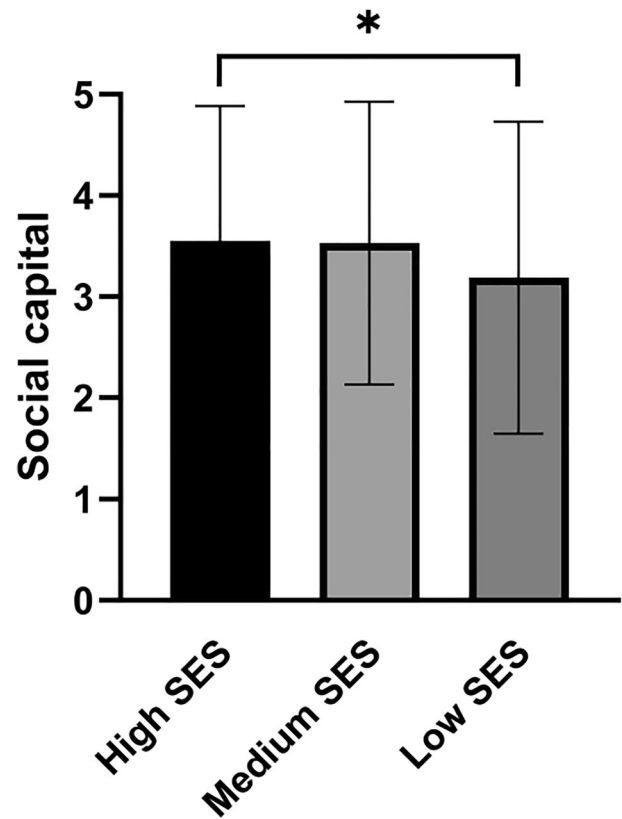


Fig. 2 Disparity of social capital among SES groups.

times; for every unit increase in social capital of the low SES students, the probability of obtaining a higher education opportunity increases by 1.739 times.

Influence of social capital on digital literacy across SES groups. The association between social capital and digital literacy was subsequently examined using linear regression. The results in Table 4 reveal that there is a significant positive correlation between social capital and digital literacy in the full sample, with a standardized correlation coefficient of 0.608 ($p < 0.001$), indicating that each additional unit of social capital was associated with a 0.608 unit increase in digital literacy. The results of group regression show that for a one-unit increase in social capital of students in the high SES group, their digital literacy significant

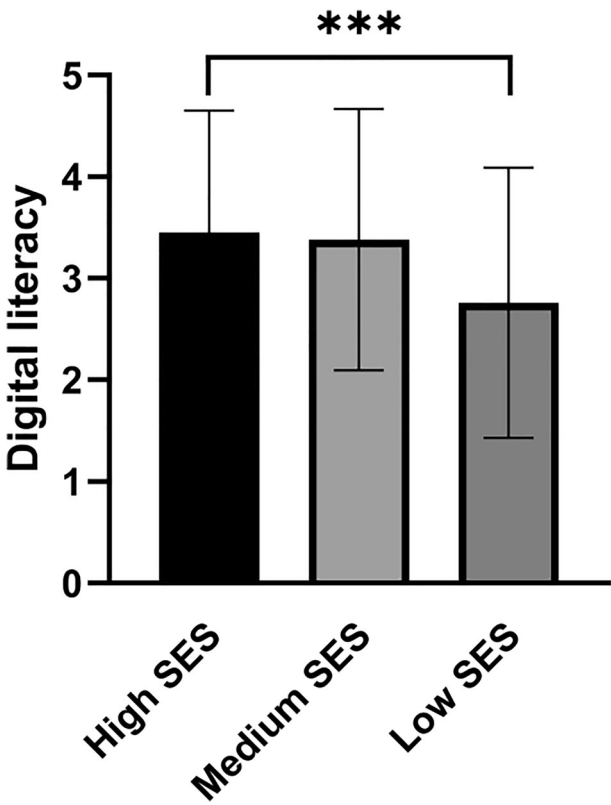


Fig. 3 Disparity of digital literacy among SES groups.

increase by 0.578 units; for a one-unit increase in social capital of students in the medium SES group, their digital literacy significant increase by 0.631 units; and for a one-unit increase in social capital of students in the low SES group, their digital literacy significant increase by 0.556 units. These results show that social capital is positively correlated with digital literacy across all SES groups.

The Mediating Role of Digital Literacy Between Social Capital and Access to Higher Education. After establishing a significant direct association between social capital and higher education attainment and confirming that social capital was positively associated with the proposed mediator, the KHB method was employed to examine the potential mediating role of digital

Table 3 Influence of social capital on access to higher education (n = 629).

Variables	Full sample	High SES	Medium SES	LowSES
Constant	0.182*** (0.091, 0.364)	0.166** (0.050, 0.554)	0.360 (0.113, 1.149)	0.097** (0.024, 0.392)
Gender	0.705 (0.477, 1.042)	0.716 (0.370, 1.386)	0.642 (0.331, 1.246)	0.864 (0.394, 1.893)
Shandow education	1.144 (0.777, 1.686)	0.944 (0.492, 1.814)	0.998 (0.522, 1.908)	1.565 (0.692, 3.539)
Household registration	1.001 (0.679, 1.474)	0.937 (0.489, 1.793)	0.939 (0.489, 1.803)	1.293 (0.579, 2.890)
<i>School type: UGHS as reference</i>				
PMHS	1.095 (0.666, 1.799)	1.525 (0.681, 3.419)	1.116 (0.482, 2.580)	0.781 (0.278, 2.198)
RGHS	0.965 (0.594, 1.569)	1.347 (0.590, 3.075)	0.824 (0.371, 1.831)	1.006 (0.367, 2.755)
<i>Region: Western as reference</i>				
Central	1.286 (0.811, 2.040)	1.339 (0.632, 2.835)	1.728 (0.789, 3.784)	0.678 (0.260, 1.772)
Eastern	1.752* (1.081, 2.839)	3.015* (1.299, 7.000)	2.056 (0.941, 4.491)	0.674 (0.245, 1.858)
Social capital	2.104*** (1.822, 2.431)	2.788*** (2.046, 3.799)	2.042*** (1.588, 2.625)	1.739*** (1.376, 2.198)
Observations	629	209	210	210

Note: *** $p < 0.001$, * $p < 0.01$, ** $p < 0.05$; n = sample size. PMHS refers to provincial model high schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Table 4 Influence of social capital on digital literacy.

Variables	Full sample	High SES	Medium SES	Low SES
Constant	0.977*** (0.145)	0.551* (0.268)	0.994*** (0.214)	1.547*** (0.269)
Gender	0.012 (0.078)	-0.020 (0.153)	0.060 (0.111)	-0.047 (0.145)
Shandow education	-0.084 (0.078)	0.012 (0.156)	-0.184 (0.111)	-0.133 (0.143)
Household registration	-0.019 (0.078)	0.004 (0.154)	-0.006 (0.111)	-0.064 (0.144)
<i>School type: UGHS as reference</i>				
PMHS	0.126 (0.099)	0.171 (0.198)	0.251 (0.139)	-0.071 (0.180)
RGHS	0.094 (0.097)	0.343 (0.187)	0.166 (0.141)	-0.139 (0.176)
<i>Region: Western as reference</i>				
Central	0.118 (0.095)	0.355* (0.179)	0.061 (0.136)	-0.032 (0.177)
Eastern	0.274** (0.096)	0.141 (0.193)	0.337* (0.137)	0.227 (0.172)
Social capital	0.608*** (0.027)	0.578*** (0.050)	0.631*** (0.042)	0.556*** (0.051)
Observations	629	209	210	210
R-squared	0.451	0.467	0.534	0.381

Note: *** $p < 0.001$, * $p < 0.01$, ** $p < 0.05$; n = sample size. PMHS refers to provincial model high schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Table 5 Mediating effect.

Access to HE	Coefficient	Std. err.	z	P > z	[95% conf. interval]
Reduced	0.751	0.074	10.180	0.000	0.607 0.896
Full	0.475	0.089	5.340	0.000	0.300 0.649
Diff	0.277	0.064	4.340	0.000	0.152 0.402

literacy. As shown in Table 5, in the reduced model, which excluded the mediator, social capital was indicated as having a significant total effect on access to higher education ($\beta = 0.751$, $p < 0.001$).

After digital literacy was included in the full model, the direct effect of social capital on access to higher education remained significant but declined ($\beta = 0.475$, $p < 0.001$), suggesting a partial mediation effect. Calculated by the KHB method, the mediating effect of digital literacy was 0.277 ($p < 0.001$), and the mediating ratio was 36%.

Influence of social capital on access to different types of higher education. To further examine the relationship between social capital and different types of higher education, the multivariate logistic regression analysis was conducted. The outcome variable differentiated the access to higher education to research universities (RU), applied universities (AU), and vocational colleges (VC, the reference category). The results are shown in Table 6;

social capital was positively correlated with the increased probability of access to RU and AU compared to VC. In the full sample, for each one unit increase in social capital, the probability of admission to a RU increased by 3.859 times ($p < 0.001$) and the probability of admission to an AU increased 2.754-fold ($p < 0.001$).

The group regression results show that for each unit increase in social capital of high SES students, the probability of entering a RU increases by 5.121 ($p < 0.001$); for each one-unit increase in social capital of medium SES students, the probability of entering a RU increases by 4.627 ($p < 0.001$); for each one unit increase in social capital of low SES students, the probability of entering a RU increases by 3.596 ($p < 0.001$). Regarding the probability of accessing an AU, for each one-unit increase in social capital of high, medium, and low SES students, the probability of accessing an AU increases by 2.577 ($p < 0.001$), 3.672 ($p < 0.001$), and 2.677 ($p < 0.001$), respectively.

Association Between Social Capital and Digital Literacy Among University Entrants.

To explore the relationship between social capital and digital literacy of students who have access to higher education, regression models were constructed for the full sample and subgroups of different SES groups. The results in Table 7 show that in the full sample, social capital is significantly positively correlated with digital literacy, with a standardized correlation coefficient of 0.608 ($p < 0.001$), that is, for a one-unit increase in social capital, digital literacy increases by 0.608 units.

Table 6 Influence of social capital on access to different type of HE ($n = 436$).

Variables	Access to RU		Access to AU					
	Full sample	High SES	Medium SES	Low SES	Full sample	High SES	Medium SES	Low SES
Constant	0.003*** (0.001, 0.017)	0.001*** (0.000, 0.019)	0.009*** (0.001, 0.129)	0.001** (0.000, 0.153)	0.027*** (0.009, 0.084)	0.006*** (0.001, 0.053)	0.039*** (0.006, 0.240)	0.046** (0.005, 0.406)
Gender	0.869 (0.466, 1.619)	1.443 (0.548, 3.801)	0.482 (0.160, 1.449)	0.545 (0.095, 3.142)	1.108 (0.670, 1.833)	1.926 (0.805, 4.607)	0.775 (0.316, 1.900)	0.873 (0.330, 2.305)
Shadow education	0.766 (0.408, 1.436)	0.597 (0.224, 1.591)	0.910 (0.310, 2.668)	1.076 (0.208, 5.579)	0.792 (0.476, 1.320)	1.115 (0.463, 2.685)	0.729 (0.307, 1.733)	0.668 (0.245, 1.819)
Household registration	0.699 (0.373, 1.311)	0.599 (0.220, 1.637)	0.920 (0.311, 2.719)	0.355 (0.066, 1.904)	1.160 (0.701, 1.919)	0.858 (0.350, 2.099)	2.079 (0.863, 5.011)	0.760 (0.284, 2.038)
School type: PMHS as reference								
UGHS	0.918 (0.415, 2.027)	1.196 (0.336, 4.254)	0.805 (0.217, 2.988)	0.424 (0.052, 3.452)	0.679 (0.357, 1.293)	0.763 (0.255, 2.278)	0.521 (0.173, 1.564)	0.715 (0.196, 2.604)
RGHS	0.814 (0.375, 1.767)	1.019 (0.286, 3.624)	0.669 (0.177, 2.527)	0.443 (0.070, 2.801)	0.726 (0.387, 1.363)	0.522 (0.170, 1.604)	0.698 (0.238, 2.048)	0.779 (0.236, 2.570)
Region: Western as reference								
Central	1.060 (0.480, 2.339)	1.333 (0.375, 4.733)	0.535 (0.133, 2.147)	1.240 (0.189, 8.155)	1.446 (0.787, 2.658)	1.293 (0.447, 3.743)	1.271 (0.425, 3.799)	1.958 (0.645, 5.943)
Eastern	3.032** (1.412, 6.511)	6.356** (1.773, 22.790)	0.865 (0.253, 2.956)	5.085 (0.620, 41.675)	2.078* (1.100, 3.926)	2.844 (0.913, 8.860)	1.148 (0.402, 3.280)	4.469* (1.144, 17.464)
Social capital	3.859*** (2.761, 5.395)	5.121** (1.720, 15.249)	4.627*** (2.641, 8.106)	3.596*** (2.102, 6.152)	2.754*** (2.197, 3.454)	2.577*** (1.670, 3.976)	3.672*** (2.290, 5.886)	2.677*** (1.855, 3.862)
Observations	436	145	145	146	436	145	145	146

Note: ***, ** p < 0.001, * p < 0.01, *p < 0.05; n = sample size. PMHS refers to provincial model high schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; n = sample size. PMHS refers to provincial model high schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Table 7 Influence of social capital on digital literacy (n = 436).

Variables	Full sample	High SES	Medium SES	Low SES
Constant	1.674*** (0.211)	1.108* (0.458)	1.524*** (0.300)	2.352*** (0.371)
Gender	0.060 (0.104)	0.019 (0.231)	0.145 (0.142)	-0.016 (0.190)
Shandow education	-0.027 (0.104)	0.045 (0.233)	-0.056 (0.143)	-0.068 (0.186)
Household registration	-0.010 (0.104)	-0.084 (0.229)	0.081 (0.145)	-0.005 (0.188)
<i>School type: PMHS as reference</i>				
UGHS	0.107 (0.131)	0.233 (0.298)	0.191 (0.180)	-0.160 (0.231)
RGHS	0.184 (0.128)	0.545* (0.273)	0.215 (0.180)	-0.175 (0.234)
<i>Region: Western as reference</i>				
Central	0.137 (0.128)	0.413 (0.264)	0.100 (0.180)	-0.155 (0.238)
Eastern	0.380** (0.127)	0.309 (0.293)	0.460* (0.177)	0.179 (0.224)
Social capital	0.419*** (0.040)	0.456*** (0.058)	0.382*** (0.068)	0.421*** (0.084)
Observations	436	145	145	146
R-squared	0.231	0.233	0.336	0.202

Note: *** $p < 0.001$, * $p < 0.01$, ** $p < 0.05$; n = sample size. PMHS refers to provincial model high schools, UGHS refers to urban general senior high schools, and RGHS refers to rural general senior high schools.

Table 8 Mediating effect.

Access to different types of HE	Coefficient	Std. err.	z	P > z	[95% conf. interval]
Reduced	1.121	0.122	9.190	0.000	0.882 1.359
Full	0.807	0.115	7.020	0.000	0.582 1.033
Diff	0.313	0.062	5.080	0.000	0.192 0.434

The results of group regression analysis show that for a one-unit increase in social capital of students in the high socioeconomic status group, digital literacy increases significantly by 0.456 units ($p < 0.001$); for a one-unit increase in social capital of students in the middle socioeconomic status group, digital literacy increases significantly by 0.382 units ($p < 0.001$); for a one-unit increase in social capital of students in the low socioeconomic status group, their digital literacy increases significantly by 0.421 units ($p < 0.001$). The results demonstrate that social capital is positively correlated with digital literacy in all socioeconomic status groups.

Mediating Role of Digital Literacy in the Relationship Between Social Capital and Access to Different Types of Higher Education. To assess whether digital literacy mediates the relationship between social capital and access to different types of higher education, this study adopted the KHB method. The subjects of analysis were students who had access to higher education. As shown in Table 8, in the model without the mediating variable, the total effect of social capital on access to different types of higher education is significant ($\beta = 1.121$, $p < 0.001$).

After incorporating digital literacy into the full model, the total effect of social capital on higher education is still significant, but it has decreased ($\beta = 0.807$, $p < 0.001$), indicating that it has a partial mediating effect. Using the KHB method, the mediating effect of digital literacy is 0.313 ($p < 0.001$), and the mediating ratio is 28%.

Discussion

Based on Bourdieu's theory of capital and social reproduction, this study examines the path by which social capital influence access to higher education of high school graduates through digital literacy. The study found that there are hierarchical differences between different SES groups, which are reflected in differences in social capital and digital literacy, as well as the stratified structure of higher education. The results show that social capital is related to whether graduates receive higher

education and the type of higher education they receive, and digital literacy plays a partial mediating role in this. The research also offers important insights into the evolving mechanisms of social reproduction in the digital context and provides a new perspective for understanding educational inequality.

This study discovered a significant positive correlation between social capital and digital literacy, which echoes Bourdieu's (1986) capital conversion theory. However, this study further clarifies the mechanism of capital conversion in the digital age and provides empirical evidence to support the theoretical perspective of digital literacy as a new type of cultural capital. Digital literacy has emerged as a new form of cultural capital, influencing students' ability to navigate online information, utilize social networks, and access educational opportunities in ways that transcend traditional measures of cultural capital. Previous studies have regarded digital literacy as a new type of cultural capital with educational reproduction functions (Tondeur et al., 2011; Pitzalis and Porcu, 2024). This study further incorporates it into Bourdieu's capital conversion theory, revealing that social networks enhance students' ability to access digital resources by providing information, support, and resources, which are ultimately transformed into the technological dimension of cultural capital. However, this conversion mechanism differs among different SES groups, being more significant in high and medium SES groups, but also showing a positive effect in low SES students. The results of this study are consistent with Liu et al.'s (2021) views on the relationship between family background and digital competence development.

This study finds that social capital is closely linked to whether high school graduates go on to higher education and what type of institution they attend. This supports Bourdieu's (1986) idea that social networks help students get useful information and support, which can shape their learning and choices about higher education institutions. The results also show that social capital plays an important role across all SES groups. No matter their family background, students who have strong support networks are more likely to facilitate their transition into higher education (Guan and James, 2020; Hu, 2023).

This study further highlights the role of social capital in access to different types of higher education opportunities (Hu, 2023), especially in the process of students entering resource-rich elite institutions (such as research universities). Bourdieu (1986) believes that higher education itself is a symbolic differentiation mechanism. This institutionalized distinction is obvious at the stage of student enrollment, but its roots are deeply rooted in the early preparation stage of pre-university education, information acquisition, and school selection decisions. Social capital provides information and support in these processes and forms a cultural literacy (habitus) that enables students to pursue specific educational goals under clear guidance and adequate preparation (Guan and James, 2020). Consequently, this study emphasizes that the reproduction of inequality is not only reflected in the surface level of whether or not higher education is obtained; it is also deeply rooted in the implicit mechanism of obtaining specific types of higher education.

Although the relationship between social capital and higher education opportunities is significantly positive across all SES groups, this association is particularly evident among high-SES students, especially in terms of admission to elite institutions. This reflects how the unequal distribution of social capital between different social groups affects students' educational trajectories (Calderon Gomez, 2021). As Bourdieu (1986) pointed out, the process of converting social capital into other forms of capital (such as cultural capital) is influenced by the social and institutional environment. Students from high-SES backgrounds benefit from networks embedded in mainstream institutions, such as family members who have access to information about elite universities, faculty members who are familiar with academic preparation, or peer groups oriented toward academic excellence (Tuominen and Tikkanen, 2023). These networks provide informational and emotional support, as well as instrumental guidance that is consistent with institutional norms and expectations, thereby enhancing their competitiveness in the elite selection process. In contrast, the networks of low-SES students often lack alignment with institutional norms or resources, and therefore cannot obtain similar advantages. Therefore, while social capital is positively associated with higher education pathways, it is also a mechanism for student stratification within the higher education system, reinforcing the reproduction of educational opportunities.

This study confirms the mediating role of digital literacy between social capital and higher education opportunities, explains how social capital is transformed into digital literacy and reproduces educational opportunities, and reveals the mechanism of educational inequality in the digital age. This finding contributes to theory by highlighting the unique role of digital literacy within a broader cultural capital framework, particularly in technology-driven educational settings. As the digital dimension of cultural capital, digital literacy represents the ability to actively acquire and utilize resources in the context of technological culture (Pitzalis and Porcu, 2024). Furthermore, this study makes a theoretical contribution by identifying the impact of heterogeneity across SES groups. While previous research has confirmed the role of social and cultural capital in shaping educational opportunities, our results suggest that the acquisition of digital literacy is not evenly distributed across social classes. Instead, it is associated with the total amount of resources provided by unequal social capital shaped by SES (Calderon Gomez, 2021). In other words, individuals with extensive and high-quality social networks are able to acquire and master this new cultural capital earlier and more effectively, while students from low SES groups, due to their limited digital skills, perform unevenly, suggesting that traditional measures of cultural capital may underestimate inequality in digital education environments. This heterogeneity

highlights that the mechanisms of educational inequality are constantly evolving with the innovation of digital technologies, exhibiting characteristics of hiddenness and technological complexity. Digital literacy, as a differentiated resource, can amplify or weaken existing advantages, thereby expanding the traditional cultural capital framework.

This study highlights the differences in access to educational resources among different SES groups and reveals the complex interactions between multiple factors affecting inequality. In the digital age, SES interacts with social capital and cultural capital (digital literacy) to jointly constitute the gap in students' educational opportunities. For example, low-SES students may lack high-quality social networks, have insufficient digital literacy, and attend schools with limited resources. These intertwined constraints reinforce what Bourdieu calls the habitus structure, that is, the social status of an individual limits his or her behavior patterns and development opportunities (Jackson, 2022; Tuominen & Tikkanen, 2023). The differences in the efficiency of social capital conversion among different SES groups indicate that inequality is a superimposed and cumulative process. This process reinforces the existing social stratification in the field of education and forms a gradually solidified reproduction mechanism.

This study has implications for addressing educational inequality in the digital environment. The findings suggest that digital literacy is not only a form of cultural capital but also mediates the extent to which social capital is translated into educational opportunities. Students with limited digital skills may not fully utilize their social capital, exacerbating existing disparities. This suggests that interventions should consider digital literacy as a new dimension of educational equity. First, targeted digital literacy training should be provided to students from disadvantaged backgrounds to help them translate digital resources into academic outcomes and identify educational opportunities through digital information. Second, online guidance platforms can provide personalized information interventions during the application process to reduce irrational educational decisions caused by information asymmetry. Previous research has confirmed that such interventions can improve admissions outcomes for disadvantaged students (Loyalka et al., 2013). Third, ensuring access to digital infrastructure and internet connectivity is crucial to alleviating structural barriers. Taken together, these initiatives can help narrow the digital divide and promote more equitable access to higher education in an increasingly technology-driven environment.

Limitations and future studies. Although this study provides valuable empirical findings in exploring the relationship between social capital, digital literacy and higher education opportunities, it still has some limitations. First, the data used in this study are cross-sectional in nature, which limits the ability to infer causal relationships between variables. Although the empirical analysis found that social capital and digital literacy significantly affect higher education opportunities, this impact is only reflected in statistical correlation and cannot reveal the dynamic evolution process between variables. Although we controlled for key covariates and relied on theoretical rationales to guide our interpretation, we cannot completely rule out the possibility that unmeasured factors may have influenced these associations. Second, the limited number of sampled schools may have affected the representativeness of the study. While the stratified random sampling design enhances diversity across regions and school types, it cannot fully reflect the heterogeneity of China's vast education system. This may limit the generalizability of the findings.

Future research is recommended to conduct a longitudinal research design can be adopted to track the development of students' social capital and digital literacy and reveal their long-term impact on educational decision-making and continuing education paths. Secondly, it is recommended to introduce more variables that affect access to higher education, such as academic performance and family education investment, to build a comprehensive analytical framework, enhance the explanatory power of the model and the practical relevance of policy recommendations.

Conclusions

This study highlights the critical role of social capital in shaping educational trajectories in the digital age. The results show that social capital is significantly associated with higher education enrollment and the type of institution attended. In addition, as an emerging cultural capital, digital literacy plays a partial mediating role in these relationships, revealing changes in the social reproduction mechanism brought about by technological innovation in the digital age.

This study introduces digital literacy as a new cultural capital into the capital theory framework, expanding the application of capital theory and social reproduction theory in the context of the digital age. This perspective helps to understand the mechanism by which digital development reshapes educational inequality. The evidence from this study supports the necessity of conducting digital literacy intervention projects, especially digital literacy improvement projects for disadvantaged groups, to help them master the ability to actively acquire and use digital resources to navigate higher education, thereby promoting fair access to high-quality higher education (Bourdieu et al. 1977).

Data availability

The data presented in this study are available on request from the first author.

Received: 15 June 2025; Accepted: 10 November 2025;

Published online: 09 December 2025

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Acknowledgements

The authors wish to thank the schools that voluntarily participated in this study.

Author contributions

Conceptualization, GMA.; methodology, GMA.; WSW., software, WSW.; validation, GMA., WSW., KB., and ML; formal analysis, WSW.; investigation, KB., ML; resources, WSW.; data curation, WSW. ML; writing—original draft preparation, GMA.; WSW., KB., and ML; writing—review and editing, GMA.; KB., ML., and NCH., visualization, GMA.; KB., supervision, GMA.; project administration, GMA.; funding acquisition, WSW. All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was granted by the Human Research Ethics Committee at the University Putra Malaysia UPM (JKEUPM-an Institutional Review Board -IRB) on 7 November 2024. The reference/approval number is JKEUPM-2024-439. Moreover, local approval

was obtained from the Ethics Committee (an Institutional Review Board-IRB) of Sichuan University of Arts and Science, Sichuan, China on 25 September 2024. The approval/reference number is SCWLL20240905. The ethical procedures used in this study were in accordance with the provisions of the Declaration of Helsinki.

Informed Consent

Verbal informed consent was obtained from all participants prior to data collection, during the period from 15 November 2024 to 15 January 2025, in accordance with national regulations and institutional standards. Participants were clearly informed that the study involved the use of both their questionnaire responses and secondary data, including SES and university admission outcomes, which would be matched via their student identification numbers. They were assured that this information would be used solely for research purposes, remain strictly confidential, and presented in anonymized and aggregated form. Ethical approval for this study, including approval of the informed consent procedure for data collection and use, was granted by the Human Research Ethics Committee of Universiti Putra Malaysia (JKEUPM; Institutional Review Board, Ref. No.: JKEUPM-2024-439) on 7 November 2024, and by the Ethics Committee of Sichuan University of Arts and Science (Institutional Review Board, Ref. No.: SCWLL20240905) on 25 September 2024. The requirement for obtaining informed consent was waived for components involving the use of secondary data that do not contain identifiable personal information (Ref. No.: SCWLL20240905). These approvals confirm that the study complies with institutional and international ethical standards, including the principles outlined in the Declaration of Helsinki.

Usage of AI and software

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

Additional information

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