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A Natural Experiment by the School Grouping Policy

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Abstract

We reveal the effect of education on academic performance and preferences by analyzing a special selection system for high school entrance examinations in Japan, the "school grouping policy." Owing to the random assignment of students, the difference in performance between the schools in a group was due to their educational features. Education affected both academic performance and hometown loyalty, and the instruction on how to choose a college to apply to strongly influenced students' choices. While there is significant selection bias in most empirical studies, our findings are free from such bias and are important when considering educational policies.

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I. Introduction

Education has a wide range of effects. In economics, its impact on lifetime earnings has long been studied in depth, along with other outcomes such as health, mortality, and crime (see Lance 2011). Of course, there has been a significant body of research on the influence of education on academic performance, which has in turn led to studies on school effectiveness. Education also influences individuals' preferences, ways of thinking, and social capital. In fact, many studies empirically showed the influences of education on individuals' preferences. For example, Denny (2003) identified the positive effect of years of education on social capital, as measured by individuals' participation in voluntary and community activities. Using a meta-analysis, Huang et al. (2009) found a strong and robust relationship between education and social capital, which can be defined as such as social trust and social participation. Using data from public elementary schools in Japan, Ito et al. (2015) found that education increases altruism, cooperation with others, reciprocity, and national pride.

Therefore, education has been shown to have a positive effect on many fronts; however, how can we measure the effects of education? While there are many empirical studies on the effects of school education, it is not easy to capture the "pure" influence of school education, mainly because of endogeneities. The simplest way to examine the effectiveness of a certain curriculum is to compare schools that have adopted that curriculum with those that have not. However, this method poses serious endogeneity problems because the characteristics of the schools that have adopted a certain curriculum are most likely to differ from those who have not adopted it. For example, Epple, Newlon, and Romano (2002) found that the degree of competition with private schools increases

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the probability of adopting school tracking in public schools. As such, a comparison of public schools that adopt school tracking with those that do not reflects a difference in the level of competition with private schools. This endogeneity makes it impossible to extract the pure effects of school tracking. In school tracking research, Betts (2011) noted that it is natural for schools with a mixture of races, religions, and immigrants to use tracking to differentiate students. Again, we cannot distinguish the effects of school tracking from the influence of demographic characteristics.

Other endogeneity problems caused by school-by-school comparisons because school choice is based on the preferences of each student or their parents. For example, a preference for competition affects a student's choice of school. As Nierderle and Vesterlund (2007) showed, there is a gender difference in the preference for competition, which means that male students tend to choose high-ranked schools. This selection bias harms to measure the effects of school education. In addition, parents who consider that certain curricula or educational methods have a positive influence on their children tend to move to regions in which schools adopt these curricula or educational methods. These parental characteristics also hinder identifying the influences of school education. Some studies have attempted to decrease the effect of this endogeneity using propensity scores (Betts and Shkolnik 2000); however, it is difficult to control perfectly. Therefore, comparing schools (or classes) is not an adequate way to determine the pure influence of school education.

Another way to examine the influence of education is to compare it before and after the adoption of a certain educational method in the same school. Although a policy change is needed to achieve this, some studies used adequate settings. Examples include Pekkarinen et al. (2009) in Finland, Meghir and Palme (2005) in Sweden, and Galindo-

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Rueda and Vignoles (2007) in the UK. In this comparison, the differences by year that included the influence of other policies or birth cohorts would harm the results. In addition, the endogeneity in school choices remains. Marcenaro-Gutierrez et al. (2007) tried to reduce the endogeneity issues in attending selective schools using propensity scores; however, their results implied that selectivity bias persisted. In addition, even if endogeneity was reduced, a perfect pure comparison could not be conducted due to common shocks and cohort effects that arise from using before-and-after data.

As such, the question is: how can we determine the influence of school education? Recently, some econometric methods have been developed to reduce these endogeneity problems, such as instrumental variables, regression discontinuity, and the empirical Bayes methods (see Angrist, Hull, and Walters 2023). However, a setting in which school assignments are random would be free from endogeneity problems, including selection bias in the first place. In this study, we found such a setting, namely natural experimental situation to reveal the influence of school education. The natural experimental situation we used is a policy called the "school grouping system," adopted in specific areas in Japan during specific periods. As described in Section II, under this policy, junior high school students chose a "school group" to apply to, which generally consisted of two high schools. After taking the entrance examination, they were randomly assigned to one of the high schools in that school group under the policy. Because of this random assignment, our data are free from endogeneity problems and the characteristics of the incoming students in the two schools are statistically equal. Therefore, we can interpret that the difference in performance between the two schools is due to the educational features of each school. Usually, the difference in outcomes between two schools comes from educational methods (including curriculum, teaching method,

tracking, and school spirit), selection bias, and peer effects, but it is difficult to separate these factors from each other. However, under the school grouping policy, the difference in outcomes between two schools belonging to the same school group comes only from education, because there is no selection bias and no difference in the size of the peer effect under this random assignment.

Using this natural experimental setting, we reveal the features of education for each school cleanly. Two educational outcomes are considered in this study: academic performance and preference. We use college choice for both indicators. We focus on the preference of loyalty to one's hometown. In terms of college choice, in Japan, it is usual for high school students to decide on two things at the same time: how high-ranked are the universities they will apply to and how far away are these universities? The difficulty of entering university can be considered to reflect academic performance, and the decision to attend a local university is a measure of hometown loyalty. As it is relatively common for adults to live with their parents in Japan, it is a huge decision for high school students to live alone in distant regions. It is often observed that a student has the ability to go to a high-ranked university in an urban area, but they choose a local university which is lower-ranked. For example, according to the School Basic Survey (2020), the average rate of students who attend university in the same prefecture as their high school is 42.7% (the largest is 77.8% in Okinawa Prefecture and the smallest is 20.0% in Shiga Prefecture) out of the number of students who attend four-year universities in their prefecture. If education increases students' loyalty to their hometowns, the number of students applying to local universities will increase.

Some extant studies have shown that loyalty to one's hometown is an important factor in college choice in Japan. For instance, based on a survey of high school students

in rural areas in Japan, Tomie (1997) showed that the eldest child tends to choose to go to a local college on purpose. Hirao and Shigematsu (2006) conducted an original survey of high school students in Yamaguchi Prefecture, which is not an urban area in Japan, and found that students who have strong loyalty to their hometowns (students who answered that they want to work with living in their parents' houses or work in their home prefecture) are not active in job hunting. For example, such students were not willing to work, did not have the job they wanted, and could not picture themselves as working. Interestingly, however, they well discussed with their parents about job hunting or future jobs. Kudoh (2006) conducted an original survey of high school students from three schools in the urban and rural areas of Japan. He showed that there are large differences between urban and rural areas in the reasons for attending university and choosing a career path. They also observed differences in social capital. In rural areas, high school students tend to ask for advice from adults, including their parents and teachers, when they encounter an important event, whereas students in urban areas tend to ask their friends.

Therefore, the outcome that we use in this study is the number of students who have passed university, which we compare in two dimensions: the number of students who apply to high-ranked universities and the number of students who apply to local universities. We compare these numbers between the schools in the same school group, and if there are some differences in the school grouping policy between the two schools, we can conclude that each school's education influences the growth of the loyalty to one's hometown and academic performance. Details of Japanese universities and their entrance examination systems are explained in Section II.C.

The rest of this paper is organized as follows. Section II presents our data,

including an explanation of the details of the school grouping policy and university entrance examination system in Japan. Section III highlights the results. Finally, Section IV presents the discussion and conclusions.

II. Method

A. School Grouping Policy

The school grouping system aimed to decrease discrimination among high schools. For this purpose, two or three high schools form a "school group" and the students choose which "school group" they apply to. Students who pass the entrance examination are randomly assigned to one of the schools in that school group. Students are thus unable to choose a specific high school. There is no way to change the results of the random assignment or make an objection; hence, this system was known to produce great dissatisfaction among students. Official documents that clearly state the allocation method prove that this was done completely randomly.

The school grouping system has been adopted in only six prefectures in Japan (Tokyo, Chiba, Aichi, Gifu, Mie, and Fukui). The period during which this policy was adopted varied between prefectures, for example, from 1967 to 1981 in Tokyo and from 1973 to 1988 in Aichi. However, all school grouping policies ended in 2004.

B. Our Data

Our data are collected from two schools in Toyohashi City, Aichi Prefecture. Toyohashi City is located at the middle point between Tokyo and Osaka, which are the largest and second largest cities in Japan, respectively. It takes approximately two hours from Toyohashi to both Tokyo and Osaka by bullet train. Toyohashi is in the easternmost

part of Aichi Prefecture, and the nearest large city is Nagoya.

Although the Toyohashi School area of Aichi Prefecture has two school groups, we analyzed only one (which contains two high schools). This is because only one of the school groups gave us permission and access to their data. We visited each high school and collected paper documents such as school bulletins as noted in detail below. There is no online data nor government statistic data. Our data contained two high schools belonging to the same school group: traditional school A and new school B. These schools are preparatory schools, not vocational ones. Aichi Prefecture applied the school grouping policy to students who began high school between 1973 and 1988. This means that the students graduated from high school between 1975 and 1990. Hereafter, we used the graduation years as a time indicator.

Our data were obtained from school bulletins. Both schools published annual school bulletins for the students and their parents, which contained information on how many students passed the entrance examination for each college, the awards in club activity, reports of school events, short essays by teachers, and results of physical measurements. However, there is limited common information between the two schools, except for the number of college admissions.

Data were not gathered from three years because bulletins were not available for school A in 1975 and for school B in 1977 and 1995. Therefore, we omitted these years for both schools from the following analysis. The school group system was applied to these two high schools from 1975 to 1990. We only used data for this period; that is, our data consisted of pairwise data for 14 years. The average number of students per grade during this period was 412.7 (SD = 25.31, min = 360, max = 461) in school A and 343.00

(SD = 34.53, min = 272, max = 376) in school B.[1]

C. University Admissions in Japan

We used the number of students who passed the entrance examination in each college to measure their academic performance. Before explaining the details of our academic performance measures, we discuss the university admission system in Japan.

In Japan, the career path of high school students involves getting a job or going to an advanced school (university, junior college, or vocational college). Generally, university education lasts four years, while junior and vocational college takes two years. According to the School Basic Survey (2023), 14.2% of high school students found a job, 57.7% attended university, 3.4% attended junior college, and 21.9% attended vocational college in 2023. The percentage of those getting a job has decreased from 42.2% in 1976, the first year of our data, to 35.2% in 1990, the end of our data.

Japanese universities can be classified as public or private. Public universities include national, prefectural, and urban ones. In addition, national universities have been differentiated into ex-imperial universities and others. The seven ex-imperial universities are the most difficult to enter. Applicants to public universities are required to take a standardized examination (National Center Test for University Admissions), as well as specific examinations at each university. There are only two opportunities to take a specific examination to enter public universities; therefore, students cannot apply to three

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[1] This difference comes from the home economics course in school B, which has around 50 students per grade. We excluded this course from our analysis because the entrance examination for the home economics course had been exempted from the school grouping policy. The classes of general courses and home economics course are completely segregated and they have totally different curricula.

or more public universities in the same year. However, private universities provide a larger number of entrance examinations. It is not necessary to take a standardized examination for private university admission, and students can sometimes skip all or some subjects of the university's specific examination if they pass the standardized exam. The number of subjects required also differs between public and private university entrance exams. Public universities require all five subjects (English, Japanese, math, science, and social studies), whereas private schools demand only some of these. Therefore, strategy and cost differ significantly depending on whether the first choice is a public or a private university.

In general, public universities in Japan are more difficult to enter than private universities. However, there are some private universities that are as difficult to enter as public institutions. Table 1 ranks the difficulty of the entrance exams for universities. In this ranking, national universities hold top-ranking positions; however, some private universities, such as Waseda and Keio, are also highly ranked.

There are also two types of two-year colleges: public and private. However, a standardized exam, either public or private, is not required. The number of examination subjects generally ranges from one to three, and there are many opportunities to take the entrance examination because different colleges hold the examination on different days.

Table 1: University Ranking Based on Entrance Examination Difficulty in Japan

Rank	Name	School Type
1	The University of Tokyo	National
2	Waseda University	Private
3	Kyoto University	National
4	Keio University	Private
5	Sophia University	Private
6	Hitotsubashi University	National
7	Tokyo Institute of Technology	National
8	Hokkaido University	National
9	Doshisha University	Private
10	Osaka University	National

Notes: The data are sourced from the "University entrance difficulties ranking" by Toshin High school (2020). We created this ranking table by excluding the faculties of medical science because the difficulty level for entrance to these generally differs from the difficulty level of a specific university. The original ranking includes the difficulties for entering each faculty, but we created this table by choosing the highest-ranked faculty at each university.

D. Measurement of Outcomes

We measured both academic performance and hometown preference based on students' college choices. Note that we were only aware of the number of students who

were accepted to each college and not the number of students actually attending them. Several universities, especially for private universities, permit candidates to take the entrance examinations multiple times; hence, the data reveal the total number of admissions to be greater than the number of students actually attending the college. However, the number of admissions can be used as a reliable indicator because students typically apply only to the universities they are willing to attend. We used the number of admissions for universities and two-year colleges to measure the academic performance of each school under the school grouping policy.

To measure the preference for hometown, we defined "local colleges". We asked three evaluators from Toyohashi to define "local colleges." One of the evaluators is one of the authors who lived in Toyohashi city until entering university. The other two evaluators were recruited through a crowdsourcing site. We recruited the evaluators on the condition that they had lived in Toyohashi City, attended junior high and high school there, and were born between 1957 and 1972 (that is, they had experienced school grouping policy during their high school years).[2] We asked the evaluators to "Mark the university that you feel (1) is a local university, (2) is a broad-sense local university, or (3) is not local university." We picked up the colleges that all three marked as "local colleges." We asked them to evaluate only universities, so we do not know whether two-year colleges are considered local.

The evaluated results showed that the "local college" was considered the colleges that the students can go to every day from their parents' house in Toyohashi city. This includes Hamamatsu City in Shizuoka Prefecture (the westernmost city of the

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[2] We did not actively recruit two people. We searched for individuals who met these conditions within a sufficient time period (two weeks) and, as a result, only two people were recruited.

neighboring prefecture to the east of Aichi) and all areas in Aichi Prefecture (including the southernmost area of Chita City and the easternmost area of Inazawa City). While Gifu Prefecture and Mie Prefecture are both adjacent to Aichi Prefecture, it is difficult to travel there every day from Toyohashi City because it takes more than two hours by train. The colleges in the Gifu and Mie prefectures are thus excluded from "local colleges"; however, it was defined "broad-sense local colleges." This category includes colleges that Toyohashi residents feel a sense of locality to although it is difficult to travel to them from Toyohashi City every day. The "broad-sense local colleges" include colleges in the adjacent prefectures, that is, Mie, Gifu, Shizuoka, and Nagano.

III. Results

A. The Impact of the School Grouping Policy

We begin with representing the impact of the school grouping policy. For this analysis, we included data from 1991 to 1993, that is, after the implementation of the school grouping policy. Figure 1 represents the number of those admitted to the most difficult universities (ex-imperial universities) and relatively easy colleges (two-year colleges) from the two schools. In the following analysis, the number of admissions for each college is shown as the ratio of the number of students each year, because the total number of students and the number of students who attended a specific college (not getting a job) varied from year to year.
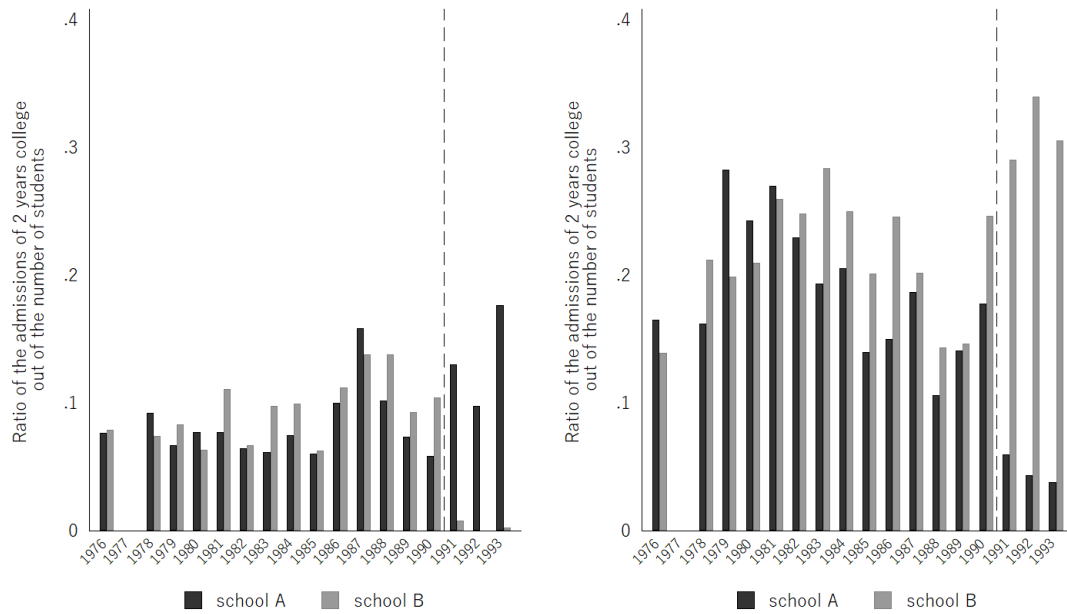
Figure 1: The Effects of the School Grouping Policy

Notes: Year indicates the year of graduation. The vertical dashed line represents the end

of the school grouping policy.

As shown in Figure 1, a large selection bias was observed after the end of the

school grouping policy. During this policy, there were no large differences in the number

of difficult university and relatively easy college admissions between schools A and B.

However, after the end of the school grouping policy, the number of difficult university

admissions for school B decreased greatly (see the left panel of Figure 1) and that of

relatively easy colleges increased significantly (right panel of Figure 1). This means that

students who wanted to attend higher-ranked universities chose school A, while students

who were not very studious went to school B. This result indicates the danger of using

data for periods when the school grouping policy was not in place and provides evidence of randomization during this policy.

B. Academic Performance

First, we obtained the ratio of students who were admitted to difficult universities out of all students for each school in terms of academic performance. We conducted a nonparametric test, the Wilcoxon signed-rank test, because it was clear that the number of admissions in each year was not normally distributed. The Wilcoxon signed-rank test is a nonparametric version of the paired t-test. We compared the outcomes for each year with those free from a time trend. The results are summarized in Table 2. The percentages of students who are admitted to all universities, including ex-imperial, national, and private universities, were significantly different between the two schools at the 1% level. As the z-value is calculated as the distribution of school A minus that of school B, negative z-values indicate that school B has more admissions than school A. Ex-imperial and national universities are difficult to enter; therefore, the results show that school B had higher academic performance than school A.

Table 2: Differences in Academic Performance between Schools

Category	Mean of school A	Mean of school B	z-value	p-value
(1) Percentage of students accepted to universities	1.168	1.286	-2.731	0.006
(2) Percentage of students accepted to ex-imperial universities	0.080	0.092	-1.977	0.048
(3) Percentage of students accepted to national universities	0.337	0.356	-2.354	0.019
(4) Percentage of students accepted to prefectural or city universities	0.053	0.052	-0.596	0.551
(5) Percentage of students accepted to private universities	0.771	0.869	-2.794	0.005
(6) Percentage of students accepted to two years college	0.187	0.219	-1.726	0.084
(7) Percentage of students that took a gap year out of the total number of students	0.708	0.648	2.062	0.039
(8) Percentage of students that took a gap year out of the number of students who were admitted with no gap year	0.508	0.431	2.271	0.023

Notes: The percentages from (1) to (6) are based on the total number of students each year. The means represent the averages for all years. The z- and p-values represent the results of the Wilcoxon signed-rank tests. The null hypothesis of this test was that the distribution of the two schools was the same.

Our second academic performance indicator was the number of students in a gap year. In Japan, it is common to take a gap year and attend the college entrance examination the following year. According to the School Basic Survey (2023), 18% of students entered university after one or more gap years. The more difficult it is for a student to apply to a university, the more likely they are to take a gap year. We obtained the number of students who were accepted to a university after taking one or more gap year. We then obtained the ratio of these students out of all admissions and used it to proxy academic performance. For this analysis, we used only data obtained after 1978. School B was established in 1973, meaning that the first graduation was in 1975; therefore, there were no students who experienced gap years at that time. As the comparison during this period is inadequate, we used data from 1978 onward, when sufficient graduates had accumulated for school B.

The results are presented in the bottom two rows of Table 2. The number of students in the gap year at school A was significantly higher than that at school B. This shows the differences in the strategies of choosing universities between the two schools. The decision to take a gap year depends largely on high school education. In Japan, it is common for the graduates of some schools to consider applying to a difficult university even if students have to take a gap year, while other schools do not recommend taking a gap year.

C. Hometown Loyalty

Table 3 presents the results of the comparison regarding hometown loyalty. Similar to academic performance, all outcomes are shown as percentages of the total number of students. Negative z-values indicate that the percentage of school B is larger

than that of school A.

Table 3: Differences in Hometown Loyalty between Schools

Category	Mean of school A	Mean of school B	z-value	p-value
(1) Percentage of students accepted to local universities	0.168	0.197	-2.542	0.011
(2) Percentage of students accepted to local national universities	0.168	0.197	-2.542	0.011
(3) Percentage of students accepted to local private universities	0.096	0.119	-2.794	0.005
(4) Percentage of students accepted to broad-sense local universities	0.435	0.491	-2.354	0.019
(5) Percentage of students accepted to broad-sense local national universities	0.168	0.197	-2.542	0.011
(6) Percentage of students accepted to broad-sense local private universities	0.272	0.308	-1.726	0.084

Notes: The percentages from (1) to (6) are based on the total number of students each year. The means represent the averages for all years. The z- and p-values represent the results of the Wilcoxon signed-rank tests. The null hypothesis of this test was that the distribution of the two schools was the same.

Using the three-person evaluation, five and 31 universities were selected as local and broad-sense local universities, respectively. Similarly, there are two local national universities, two broad-sense local national universities, two local private universities,

and 22 broad-sense local private universities. There is only one ex-imperial (the most difficult) university for Toyohashi: Nagoya University, which is included in local national universities.

In Table 3, there are significant differences in the number of students who were admitted to local universities: the students of school B tended to be admitted local universities more than the students of school A, regardless of whether the university was difficult or easy to enter.

IV. Discussion and Conclusions

In this study, we used a natural experimental setting for the "school grouping system" policy in Japan to reveal the pure influence of education. Under this policy, junior high school students were randomly assigned to one of two schools instead of choosing their own high school. Therefore, the features of students in each school were considered statistically equal under this policy. Due to this unique random setting, we could capture the pure influence of high school education on not only academic performance but also on forming preferences about hometown loyalty. This is the major contribution of this study, as only a few studies have hitherto clearly identified the effects of education.

We also found that the difference of the college choice strategy could make the difference in academic performance between schools. This finding might be consistent with Abdulkadiroglu et al. (2022), who showed the education effects of high-ranked high schools. They found that high-ranked schools have positive effects on academic performance (SAT math scores) as well as they tend to offer advanced courses that enable students obtain qualifications in Career and Technical Education or pass an industry-recognized technical assessment. Preparing these courses and recommending them to

students is part of the strategy of each high school. In other words, school features are important for students making career choices.

Additionally, the large differences in academic performance between the two schools after the end of the school grouping policy show the strength of selection bias in empirically examining the influence of education. This is one of the main contributions of this study. Abdulkadiroglu et al. (2022) also noted a large selection bias in OLS estimation, indicating that the education effects on academic performance were generally overestimated. Our result also indicates the strength of traditional and school images. Because school A had been considered "the best local high school" by the local people in Toyohashi, this sentiment remained, so when the school grouping policy ended and the students were able to choose a high school, the students who aspired to higher education chose school A. Therefore, despite 15 years of the random assignment policy, the sense that "school A is the best local high school" did not disappear. While academic performance during the school grouping policy was higher in school B than in school A, most local people did not consider school B the best local school. This public image forms a strong selection bias among students, and this is a common situation worldwide, not only in Toyohashi.

Our findings, exhibiting the education effects on hometown loyalty preference, provide new insights, as limited studies have demonstrated this influence. Moreover, we revealed these effects through a natural experiment, which is free from selection bias. Regarding hometown loyalty, Yamamura (2017) found that the effect of this preference is long-lasting and influences the rest of one's personal life; for example, when the high school baseball team of one's hometown wins, it makes people who live far from their hometown happy. Therefore, it is important to note that high school education can affect

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hometown loyalty, which persists over the long term of one's life. This finding also provides an important suggestion and warning to educational policymakers because changing the content of education may also change students' preferences in the long run.

One of the limitations of this study is that we cannot determine the true reason for the differences in outcomes between schools. Betts (2011) presented the factors that affect students' test scores in the context of tracking, such as innate ability, other personal traits, family characteristics, teacher qualifications, teacher effort, class size, peer effects, curricula, pedagogical approaches, school characteristics, and educational activities or materials after school. All but the curricula, teacher qualifications, teacher effort, pedagogical approach, and school characteristics were statistically equal in our natural experiment. However, we could not specify which of these factors caused the differences.

Although the same limitation exists in the influence of education on loyalty to one's hometown, the influence of alumni is a factor that can be interpreted as part of the school culture. Our results showed that education in school B (the newer school) increased students' loyalty to their hometown more than for school A (traditional school). This result indicates that students of school B preferred local colleges, whereas the students of school A exhibited a nationwide spirit or preferred large cities such as Tokyo. One possible reason is that the traditional school A had more alumni than school B, and the students of school A had opportunities to witness the remarkable activities of their graduates. This leads to a longing for Tokyo or other big cities and affects students' university choices. Preferences and school culture are closely connected, because education affects the formation of preferences, thus leading to the formation of school culture.

Our study has other limitations as well. For instance, the extent to which these

results can be generalized is questionable. To confirm the results, we can conduct the same analysis in other regions that adopted the school grouping policy, for example, the Mie or Gifu prefectures, in future studies.

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